Vol. 7, No. 6 DECEMBER, 1918

THE SCIENTIFIC MONTHLY

CONTENTS

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.

NEW YORK: SUB-STATION 84

SINGLE NUMBER, 30 CENTS YEARLY SUBSCRIPTION, $3.00

A Remarkable Textbook

Barber's First Course in General Science

By FREDERICK D. BARBER, Professor of Physics in the Illinois State Normal University, MERTON L. FULLER, Lecturer on Meteorology in the Bradley Polytechnic Institute, JOHN L. PRICER, Professor of Biology in the Illinois State Normal University, and HOWARD W. ADAMS, Professor of Chemistry in the same. vii+588 pp. of text. 12mo. $1.25.

A recent notable endorsement of this book occurred in Minneapolis. A Committee on General Science, representing each High School in the city, was asked to outline a course in Science for first year High School. After making the outline they considered the textbook situation. In this regard, the Committee reports as follows:

"We feel that, in Science, a book for first year High School use should be simple in language, should begin without presupposing too much knowledge on the part of the student, should have an abundance of good pictures and plen[illegible] of material to choose from.

Barber's *First Course in General Science* seems to us to best meet these requirements and in addition it suggests materials for home experiments requiring no unusual apparatus, and requires no scientific measurements during the course. We recommend its adoption."

Other Interesting Opinions on the Book Follow:

SCHOOL SCIENCE AND MATHEMATICS:—It is one of the very best books on general science that have ever been published. The biological as well as the physical side of the subject is treated with great fairness. There is more material in the text than can be well used in one year's work on the subject. This is, however, a good fault, as it gives the instructor a wide range of subjects. The book is written in a style which will at once command not only the attention of the teacher, but that of the pupil as well. It is interesting from cover to cover. Many new and ingenious features are presented. The drawings and halftones have been selected for the purpose of illustrating points in the text, as well as for the purpose of attracting the pupil and holding his attention. There are 375 of these illustrations. There is no end to the good things which might be said concerning this volume, and the advice of the writer to any school board about to adopt a text in general science is to become thoroughly familiar with this book before making a final decision.

WALTER BARR, *Keokuk, Iowa*:—Today when I showed Barber's Science to the manager and department heads of the Mississippi River Power Co., including probably the best engineers of America possible to assemble accidentally as a group, the exclamation around the table was: "If we only could have had a book like this when we were in school." Something similar in my own mind caused me to determine to give the book to my own son altho he is in only the eighth grade.

G. M. WILSON, *Iowa State College*:—I have not been particularly favorable to the general science idea, but I am satisfied now that this was due to the kind of texts which came to my attention and the way it happened to be handled in places where I had knowledge of its teaching. I am satisfied that Professor Barber, in this volume, has the work started on the right idea. It is meant to be useful, practical material closely connected with explanation of every day affairs. It seems to me an unusual contribution along this line. It will mean, of course, that others will follow, and that we may hope to have general science work put on such a practical basis that it will win a permanent place in the schools.

Henry Holt and Company

NEW YORK BOSTON CHICAGO

THE SCIENTIFIC MONTHLY

DECEMBER, 1918

CAMOUFLAGE

By ABBOTT H. THAYER

MONADNOCK, N. H.

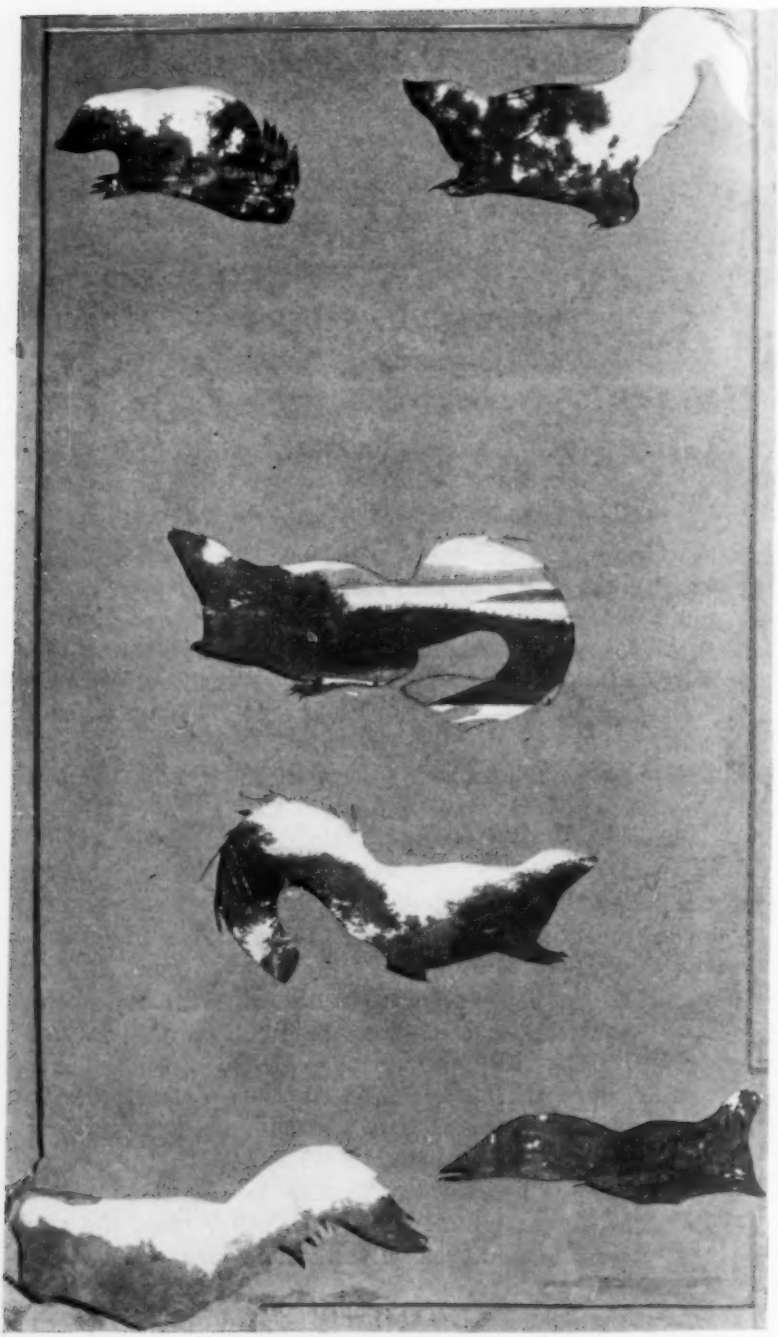
ABORIGINES in general have used camouflage in their war costume.

In their superhuman perfection, the concealing coats of animals that hunt or are hunted are now the models for the armies' camouflage corps: models so perfectly adapted to concealment in every conceivable scene, they are the despair of humanity. To study the principles underlying them, and to adapt them to the needs of the army, is now man's job.

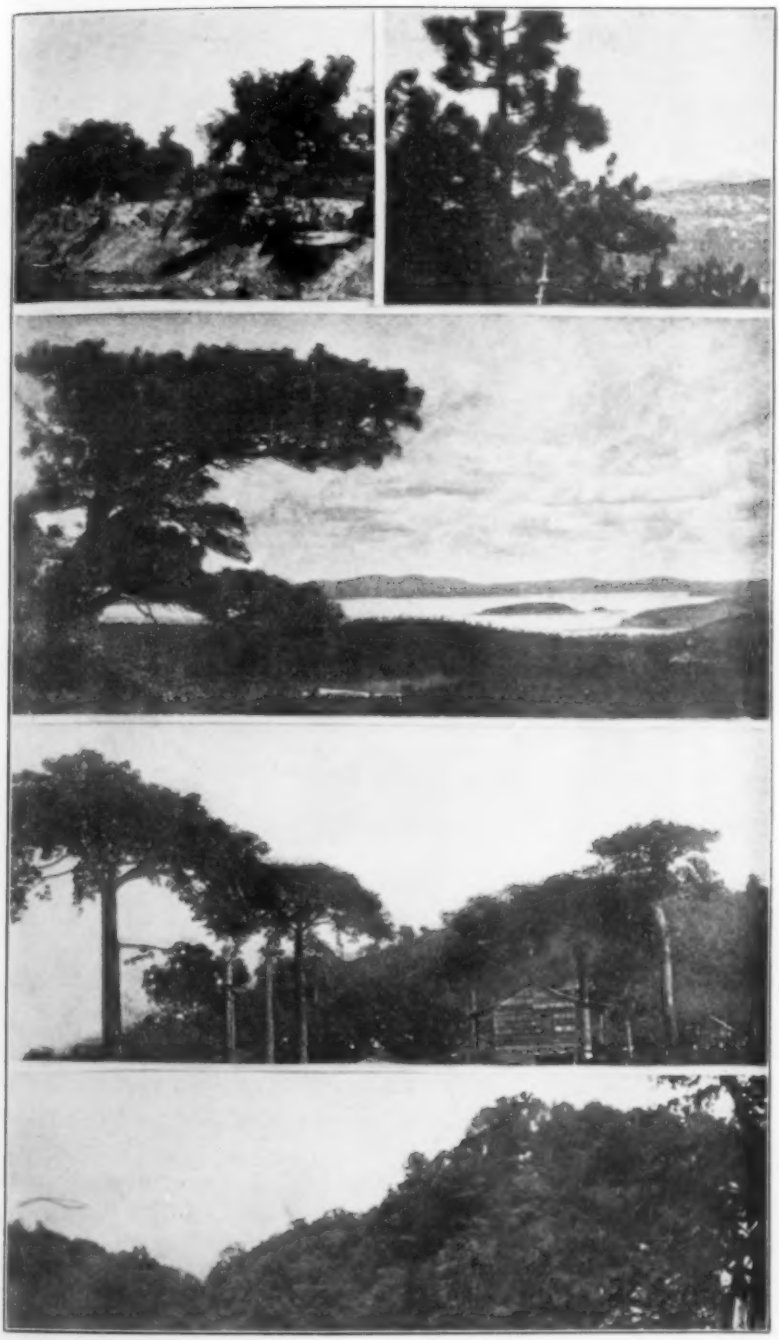
The most totally effacing costume can not be counted on to prevent its wearer's being detected when he moves enough; but even in this case it makes him a poorer target when it comes to dodging, whether it be man or beast. The white sky-faking tail feathers of warblers serve to help save these birds when pursued through the woods by hawks, where the swiftness of the chase sets all the background optically into the same motion.

Whatever question there is as to the need of animals to be concealed, as to the evolution of the patterns on them, and the purpose of these patterns, one fact in regard to the costumes of animals is demonstrable, *i. e.*, that these conceal their wearer most of all from the viewpoint of the very eyes that we believe this wearer most needs to avoid: in some the greatest need is to be enabled to catch, in others it is to escape being caught. In the one case, the skunk's or badger's white top, faking the sky, effaces their looming heads from the sight of the field mice and ground insects they are hunting; in the other case, the same black and white scheme saves on the same principle the zebra from the crouching feline.

It is a comment on the use that men make of their eyes, that with all the various uses, utilitarian, scientific and esthetic, a principle, *always in evidence*, the principle that patterns *al-*



LANDSCAPES PHOTOGRAPHED THROUGH STENCILS OF SKUNKS TO SHOW THE PROTECTIVE COLORATION OF THE WHITE SKY COUNTERFEITS.



THE LANDSCAPES PHOTOGRAPHED THROUGH THE STENCILS OF THE SKUNKS.

THROUGH A STENCIL.

ways inevitably tend to conceal, has waited till now to be discovered.

Two main oversights have caused the whole misconception as to the concealing effect of pattern on animals: one, the failing to study an animal's markings *from the viewpoint,* always, as a matter of course, *of the animal whose sight was to be deceived;* the other, the perfectly fatal confounding of *detection* with *identification after detection.*

Any pattern having color notes that are conspicuous from man's point of view insists upon recording itself upon men's minds, and has come to be considered as intrinsically conspicuous. Take, for instance, the part a skunk may play in our minds. We probably detect him oftenest by noticing a white patch going about at twilight in perhaps the neighboring field as we look down on it from our piazza. For this reason this

little beast has been set down, without further investigation, as conspicuous; while the case really is that nature has colored him for concealment from the small creatures on which he feeds, and above which he looms against the sky. (One would guess that because this white patch is so easily seen by hawks overhead nature has given him other means for his *own* protection.)

Exactly contrary to the conceptions of Darwin and his followers, pattern conceals its wearer everywhere against all backgrounds in direct ratio to its strength, *i. e.*, the degree of difference between the notes that compose it.

Monochrome, no matter how gray, *reveals* its wearer against all backgrounds whatsoever (and most of all if these are monochrome) except a background which is an absolute repetition of itself. (Of course it is the practically universal countershading of the world's animal life that alone could give it a monochrome aspect, changing the look of solidity to that of a flat surface.) Anybody will see at a glance that a monochrome area in the scene, having the shape of man, horse or bird, will

THROUGH A STENCIL.

catch the eye whenever it does not *absolutely match its background*, whereas, if the countless details of the scene recurred in the form of patterns right across this man-, horse- or bird-form, this form would be buried under this counterfeit of the scene.

On the other hand, the most monochrome of backgrounds opposes no difficulty to the concealing effect of pattern on an object seen against it, because some one of the colors of the pattern is almost sure more nearly to match the background than the other colors of it, and consequently *it* will seem to belong to the *background* rather than to the *object*.

A Brook Scene photographed through a Duck-shaped Stencil.

In cases where the colors of the pattern are all of them characteristic of the region, the deceptive imitation of the background is overwhelming; yet this resultant background-imitation is practically the universal accomplishment of animals' patterns. I have been left alone in the world to point this out; yet this whole fact is simply the ABC of all painter craft. Every painter in the world could have told you all about it the

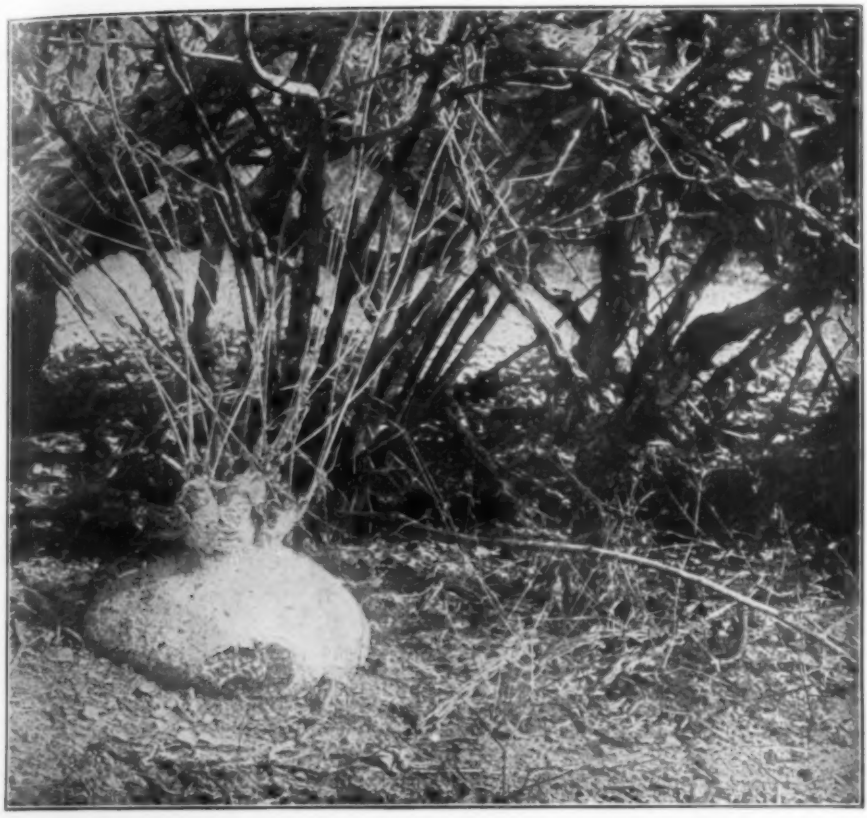
A KALINGA WARRIOR.

TATTOOED WARRIOR.
Kindness of the University Society.

SCENE PHOTOGRAPHED THROUGH THE STENCIL OF A WARRIOR.

moment you asked him. In short *every* part of the naturalist's belief on this subject has been *antipodally* wrong, and just for want of asking sight-specialists' (*i. e.*, painters') aid about matters of sight.

Here is the whole indisputable fact in a nut-shell. As all painters know, two or more patterns on *one* thing tend to pass for so many separate things. All art schools will tell you that it takes a far-advanced pupil to be able to represent the *patterns* on any decorated object so true in degree of light and darkness as not to "cut to pieces" the object itself, and destroy its reality. Objects show or don't show by silhouetting dark or light or of a different color against a more distant thing—a stick against the ground, a tree against the sky. Among the million details that constitute out-door nature, every smallest detail is only distinguishable by becoming to the spectator a pattern against its background. Consequently when nature paints with marvelous accuracy on some animal a picture of a twig and the ground, the mind inevitably accepts it as twig and



THE SCENE PHOTOGRAPHED THROUGH THE STENCIL OF THE WARRIOR.

ground. Could nature any further conceal an inhabitant of this scene than by painting superhumanly perfect *copies* of these objects on each inhabitant?

All the patterns and brilliant colors on the animal kingdom, instead of making their wearers conspicuous, are, on the contrary, *pure concealing coloration*, being the *actual color notes* of *the scene in which the wearer lives*, so that he really *is* nature's utmost *picture* of his background.

All colors and designs on animals *are pure art*, taking the lead, in the purity of their generalizations, of all human performance. Each bird's or beast's costume is pure scenery.

To discover what scene a bird represents, in cases where one plumage lasts all the year, consider what circumstances cause him the greatest need of protection, and you will commonly discover that he is *colored in representation* of such part of the scene, and such phase of it as the eyes that he most needs to avoid would see him against.

PATTERNED INDIAN AND MONOCHROME FIGURE. The Monochrome Figure may be the more distinguishable.

ARTIFICIAL ZEBRA AND ASS FROM VIEWPOINT OF A NEAR-BY STALKING LION, VIZ., A LOWER LEVEL. The Zebra concealed; the Ass revealed.

Naturalists will learn to know an animal's haunts and habits by his colors and patterns, which are nature's *utmost concealing coloration*, inasmuch as every color-coalition of any part of an animal with his background, or any presentation of the same color-note as that of any part of his background, inclines the beholder to think that he *sees background*, when he is really seeing a part of the animal. Even the scarlet bodice of the scarlet tanager by being a perfectly unbird-shaped scarlet patch amidst the forest foliage comes essentially into the same general classification because of the sprinkling throughout the forest of single scarlet leaves.

Go to the sedgy border of any water that best represents the type of place (*i. e.*, fairly level country) where antelopes, zebras, etc., would come to drink, and with your eyes a foot from the ground (crouching lions' eyes height) study through an antelope-shaped hole in a card the sky and reed-tops where they meet all about, and which would form these beasts' background to a crouching feline. What you discover is that the antelope's head-patterns example a universal costume-law, viz., those color-notes which are almost always present in the lion's view of the antelope, are fully repeated on the part of him this enemy is surest to see against such color-notes of the background. These head-patterns do the best that can be done to keep the antelopes' heads from silhouetting against the sky. They *fake* branches or reeds against the sky.

Go into the woods and in the comparatively open underwoods examine the realm between you and the sky through a similarly cut-out wood-warbler-shaped hole, and do the same to the bushes that surround your path *below* your level, etc. In this way ask the *ground* how the woodcock needs to look to escape an overhead hawk; ditto, ask how a low bush warbler; ditto, how a high tree warbler seen diagonally *above* the level of the accipiter. Remember that every bird or beast or insect picture thus made by looking at the background through that bird-, beast- or insect-shaped hole constitutes the asking nature what aspect would in that particular case totally efface such a creature in this exact situation when seen from just this viewpoint.

Next, one has only to try this on places enough to satisfy himself that he has the average. Always he will find that the costume of the species in question has every token of being *that average costume.*

An animal thus costumed tends to picture, wherever he is

From the London *Sketch.*

CAMOUFLAGE MAKE-UP. A Camouflage Scout and the same concealed in a tree.

seen from *average positions*, an average and most expectable type of scene. This morsel has very little need to fit very perfectly the surroundings it chances in any particular case to have. It merely says to the beholder, "Here is a bit of the sunny type of scenery that you know so well in this region when you direct your sight at this angle."

Looking through stencils more or less *upward* at the sky and branches will give us herons, jays, nuthatches, chickadees, etc. Looking through them more or less downward at the forest shrubbery over which the forest hawk commonly flies will give you the more or less ground-faking sparrows, etc., and such low bush foliage-faking warblers as lack the white sky counterfeit-patterns, such as the Maryland yellow throat and Canada warblers. Looking through stencils downward at the ground itself will give you ground-faking species, grouse, snipes, whippoorwills, etc.

See if you can make the stencil out-of-doors anywhere represent a flamingo save by looking at the dawn or evening sky over the lagoon, in which they are wading and against which their water enemies inevitably see them, or by looking at the water (reflecting these skies) against which the eagle would see these birds. See if you can make it represent *any* white-top-patterned species by looking at *dry* ground, or by looking in any direction save the one in which the avoided eyes would easiest detect a monochrome creature that did not absolutely match its background.

You can (any one can) look over all scences through stencils, knowing that in every case the result is God's last word as to what costume would *there*, from that viewpoint, efface its wearer.

This being the case, man has only to cut out a stencil of the soldier, ship, cannon or whatever figure he wishes to conceal, and look through this stencil from the viewpoint under consideration, to learn just what costume from that viewpoint would most tend to conceal this figure.

THE FOUNDATIONS OF BELIEF AMONG PRIMITIVE MEN

By Dr. JONATHAN WRIGHT

PLEASANTVILLE, NEW YORK

IN seeking out the origin of error and truth, fact and fancy in the history of the evolution of medicine, it soon became apparent to me that considerable thought must be devoted to a consideration of the foundations of human belief in general. It is quite impossible to follow back along the thread of progress in science with any assurance of not having lost it, unless one inquires very seriously why primitive man, or semi-civilized man, or any other man, thinks as he does. A novice in practical ethnology can view such an obstruction to the study of the origin of medicine only with dismay. He is forced from the vantage ground of original observation by the multiplicity of demands upon his capacity and his energy. He is obliged to study not only ancient primitive man in ancient texts and monuments, but he finds no opportunity, or but little, for the corrective study of prehistoric man in his own observations on modern primitive man. He has to turn to travellers' tales and accept the second-hand study of others whose opportunities are greater and whose territory is more circumscribed. It is then with all humility that I expose here a consideration of a few of the impressions which I have derived from the more original works or others. If I am forced thus to disclaim any pretence of the study of primitive man at first hand, I am also compelled to acknowledge the fragmentary and incomplete nature of the discussion I am offering. The analysis of the vast congeries of motives of human belief which are exhibited gradually to the student of human nature far surpasses the possibilities of an essay much more pretentious than this. I can only put forth those impressions I have received in sifting a certain amount of the evidence I have studied in the pursuit of some comprehension of the ideas of primitive man as to the art of medicine entirely or largely undifferentiated from other activities of a budding mentality. The investigator in the field must begin by choosing some phenomena as this which is at least partly comprehensible to him, and try to ascertain how the primitive mind arrived at such a state. The first requisite in a

seen from *average positions*, an average and most expectable type of scene. This morsel has very little need to fit very perfectly the surroundings it chances in any particular case to have. It merely says to the beholder, "Here is a bit of the sunny type of scenery that you know so well in this region when you direct your sight at this angle."

Looking through stencils more or less *upward* at the sky and branches will give us herons, jays, nuthatches, chicadees, etc. Looking through them more or less downward at the forest shrubbery over which the forest hawk commonly flies will give you the more or less ground-faking sparrows, etc., and such low bush foliage-faking warblers as lack the white sky counterfeit-patterns, such as the Maryland yellow throat and Canada warblers. Looking through stencils downward at the ground itself will give you ground-faking species, grouse, snipes, whippoorwills, etc.

See if you can make the stencil out-of-doors anywhere represent a flamingo save by looking at the dawn or evening sky over the lagoon, in which they are wading and against which their water enemies inevitably see them, or by looking at the water (reflecting these skies) against which the eagle would see these birds. See if you can make it represent *any* white-top-patterned species by looking at *dry* ground, or by looking in any direction save the one in which the avoided eyes would easiest detect a monochrome creature that did not absolutely match its background.

You can (any one can) look over all scences through stencils, knowing that in every case the result is God's last word as to what costume would *there*, from that viewpoint, efface its wearer.

This being the case, man has only to cut out a stencil of the soldier, ship, cannon or whatever figure he wishes to conceal, and look through this stencil from the viewpoint under consideration, to learn just what costume from that viewpoint would most tend to conceal this figure.

THE FOUNDATIONS OF BELIEF AMONG PRIMITIVE MEN

By Dr. JONATHAN WRIGHT

PLEASANTVILLE, NEW YORK

IN seeking out the origin of error and truth, fact and fancy in the history of the evolution of medicine, it soon became apparent to me that considerable thought must be devoted to a consideration of the foundations of human belief in general. It is quite impossible to follow back along the thread of progress in science with any assurance of not having lost it, unless one inquires very seriously why primitive man, or semi-civilized man, or any other man, thinks as he does. A novice in practical ethnology can view such an obstruction to the study of the origin of medicine only with dismay. He is forced from the vantage ground of original observation by the multiplicity of demands upon his capacity and his energy. He is obliged to study not only ancient primitive man in ancient texts and monuments, but he finds no opportunity, or but little, for the corrective study of prehistoric man in his own observations on modern primitive man. He has to turn to travellers' tales and accept the second-hand study of others whose opportunities are greater and whose territory is more circumscribed. It is then with all humility that I expose here a consideration of a few of the impressions which I have derived from the more original works or others. If I am forced thus to disclaim any pretence of the study of primitive man at first hand, I am also compelled to acknowledge the fragmentary and incomplete nature of the discussion I am offering. The analysis of the vast congeries of motives of human belief which are exhibited gradually to the student of human nature far surpasses the possibilities of an essay much more pretentious than this. I can only put forth those impressions I have received in sifting a certain amount of the evidence I have studied in the pursuit of some comprehension of the ideas of primitive man as to the art of medicine entirely or largely undifferentiated from other activities of a budding mentality. The investigator in the field must begin by choosing some phenomena as this which is at least partly comprehensible to him, and try to ascertain how the primitive mind arrived at such a state. The first requisite in a

labor of this kind is to divest oneself as completely as possible of any thought as to the correctness or the error of the fact or theory which forms the substance of the conception. Unless one realizes that this is the product of a human mind, or of a number of them, worthy of careful attention, whatever may be the particular brand of error in which the student himself is immersed; unless one realizes that in a generation or two some future critic will have the same tendency to smile or yawn over the pet beliefs that haunt contemporary thought, little advance in getting at the back of the mind of primeval man will be achieved. The next to consider is the environment in which primitive or ancient man himself was immersed. Then the history of his racial and social evolution. Finally, what is usually less important, racial idiosyncrasy of cerebral function. This is less important because usually as between the races of men the variations in the quantity and quality of cerebral function are slight apart from the effect of environment in its broad sense, inclusive of historical or evolutionary experience. For the vast majority of the races of men, cerebral capacity in its physical or anatomical sense and functional or qualitative sense is the same, while their sensations and emotions are but the reflex responses of their own forgotten acts and thoughts which in time past have been registered by the brain.[1] They have been registered there and they find expression with primitive man in a different way than with us.

Primitive man's participation in the processes of nature has caused him to assimilate into his subconscious mental processes certain moral impulses, if we may so call them, which when revealed to him in dreams influence him in a way inexplicable to the civilized man whose subconscious warehouse has been stored with a different sort of impulse and who does not heed dreams as realities, which he must take into account in shaping his actions. It is not only then that he is guided by dreams, which may indeed be summoned up from the subconscious realm by overeating, but back of the dreams lie the impressions made upon him by happenings in the forest and on the plain, by flood, fire, famine, by the scorching heat and the numbing ice. In this sense then he is indeed the child of nature, though often it is through his theories and his dreams he participates in it. Then back of his impressions are the explanations of why they have taken the form they have. It is a vicious circle. His fears, arising from his pantheistic misinterpretation of nature, guide his theories and his dreams or his theories through the

[1] Leonard, A. G., "The Lower Niger and its Tribes," London, 1906.

medium of his fears guide his actions. Primitive man, a participant with nature in her pitiless moods, "bare of tooth and red of claw," knows naught of humanitarianism, but this altruistic sentiment is merely with us an expression of social evolution which he lacks. To a certain extent this lack of social evolution may be said to be back of narrow-mindedness in a civilization just as a lack of individual evolution is back of personal narrow-mindedness. So in olden Greece there existed perhaps a pardonable arrogance which led them to draw a sharp line between the Hellenic race and barbarians. Modern science and to a large extent modern usage has obliterated this line of cleavage and we discuss the "civilization" of the Aztec, the Babylonian, the Chinese, the Bantu and the Iroquois from more or less the same point of view we do that of the Frenchmen, the Saxon or the Teuton, and, if we are to make progress in the analysis of the evolution of thought, we must not pin ourselves to standards of culture or morals or indeed of knowledge. We must treat with entire objectivity, so far as we can, the cult of the savage. It is not difficult to take an account of his material civilization, but as Lord Avebury[2] says:

> Travellers naturally find it far easier to describe the houses, boats, food, dress, weapons and implements of savages, than to understand their thoughts and feelings. The whole mental condition of a savage is so different from ours, that it is often very difficult to follow what is passing in his mind, or to understand the motives by which he is influenced. Many things appear natural and almost self-evident to him, which produce a very different impression on us. "What!" said a negro to Burton, "Am I to starve, while my sister has children whom she can sell?" When the natives of the Lower Murray first saw pack oxen, some of them were frightened and took them for demons "with spears on their heads," while others thought they were the wives of the settlers, because they carried the baggage.

At each step along the road we have traveled since the Stone Age, our environment has changed and, as the path stretches behind us, we lose sight of the impressions which the road side has furnished. It is not alone a matter of physical change in the environment, but it is also a change in the mental environment. By the side of material evolution marches a social evolution and a mental evolution. It is the latter which forms the environment in the brain of man for the idea entertained by thought or for the fact observed in the material and social evolution around. So when we think of the processes in the brain of primitive man we must, as Frazer[3] says,

[2] Avebury, Lord (Sir John Lubbock), "The Origin of Civilization and the Primitive Condition of Man," London, 1889.

[3] Frazer, J. G., "The Dying God," London, 1912.

divest ourselves of our modern conceptions of the immensity of the universe and of the pettiness and insignificance of man's place in it. We must imagine the infinitude of space shrunk to a few miles, the infinitude of time contracted to a few generations. To the savage the mountains that bound the visible horizon, or the sea that stretches away to meet it, is the world's end. Beyond these narrow limits his feet have never strayed, and even his imagination fails to conceive what lies across the waste of waters or the far blue hills. Of the future he hardly thinks, and of the past he knows only what has been handed down to him by word of mouth from his savage forefathers. To suppose that a world thus circumscribed in space and time was created by the efforts or the fiat of a being like himself imposes no great strain on his credulity; and he may without much difficulty imagine that he himself can annually repeat the work of creation by his charms and incantations.

Fundamentally the human mind, so far as etiology is concerned, is like nature; it abhors a vacuum, and it is human by virtue of this very quality which is said to separate man from the brutes. Man only with reluctance and after long wrestling with the problems before him comes to the agnostic state of mind. He must have a reason for things. "*Felix qui potuit rerum cognoscere causas.*" Savage man and modern man in the face of mystery delude themselves into thinking they have found a reason, by filling what would otherwise be a sort of vacuum, with an incomprehensible agent, vitalistic for modern science—a spirit for the savage. The very fact that he has the mental energy to fill the gap in his knowledge with *any* concept asserts his humanity in differentiation from the brute. False reasoning is vastly better than none, and agnosticism has its dangers as well as credulity. It was vastly better that he believe an anthropomorphic spirit dwells in every object, material and animate, than to give no thought at all to the "causes of things." Some savages have been observed at least partly in this state. When the savage lost his idea of an indwelling spirit he lost the idea of the process of continuity of phenomena. He became an agnostic—did not know and finally did not care. Of course this is only approximately true, for the tendency always is to fill the vacancy, but the "ignorant white man," devoid of pantheistic concepts, takes his faith on authority which is worse mentally than the heathen's fetish or his essential agnosticism in its lowest expression. We are not concerned with this phase of primitive mentality; it is one of the dead twigs on the stem of early mental evolution which has fallen out of the line of the evolution of thought. We should be quite ready to believe that "before the dawn of human reason evolution was a gradual unfolding of reality to the sentient consciousness,"[4] were it not

[4] Ward, Wilfred, *Edinburgh Review*, January, 1916, p. 73.

for the implication that humanity was born before human reason. One is less inclined to demur at the view that there were products of human mental activity which can not be dignified by the label of scientific, but we can hardly look upon this as a pre-evolutionary period. Despite the apparent chaos, we know well things then were taking shape—even though beyond our ken. Without allowing myself to be betrayed further into mere terminology, it is evident that this unfolding of reality to the sentient consciousness is the product of the environment in which of course other factors are integrated. One of the results of this has been the myth-making deductions which have, it seems to me, frequently led students of the evolution of human thought astray. It doubtless belongs to its inceptive stages.[5] The child shows obvious traces of it, but that very mental activity which in its exaggerated form in children leads them to lying, or more charitably to romancing, it seems to me is not a safe guide for the pre-historian in tracing out the processes of primitive thought and still less reliable in reading into the records of prehistoric man what was little more than the result of the suffusion of the gray matter of the brain with an increasing blood supply. Surrounding influences, so different usually from our own, at least the extrinsic ones, present a whole mass of inherent ideas to the individual consciousness of savages, and these find expression to some extent in mythological traditions which may indirectly furnish us with clues to matters otherwise dark to us, but when these are the only clues, it is safer to limit our conclusions simply to a belief in the marked cerebral activity of primitive man. When, however, we have concomitant hints of the direction such manifestations of primitive mentality take, we may venture further. Changes in the weather are preceded by certain appearances of the clouds and of the leaves of the trees and the grass of the plains, by certain actions of animals and birds. These are still obvious to the close observer of nature who lives in constant communion with her. Few educated people to-day do this. Even if they do, they are warped by their book knowledge and their theories and prejudices to such an extent that not only are they unable fully to profit by the observation of such phenomena, but they are unduly skeptical of what these phenomena meant to savage man.

In studying the old civilizations, we are reminded that the Mesopotamians, and those dwelling on the Nile, were able to prognosticate many things which escape us, but they resemble

[5] Wundt, Wilhelm, "Outlines of Psychology," tr. by C. H. Judd, third revised English edition, Leipzig, 1907.

us in the tendency to an optimism and a credulity which led them into theories entirely false. Because the swallows fly low before a storm and other birds have a peculiar note, because the migration of certain flocks presage an approaching change in the season, because a moderate number of future things are betrayed by the behavior of animate and inanimate nature they believed, or their priests and rulers feigned for their own necessities and purposes to believe, that they could by observing such behavior foresee fortune or misfortune in social and political affairs; their physicians believed or feigned to believe for their own necessities and purposes in theories of causation and methods of cure lacking logical foundation. It was not a lack of their power to observe, it was the lack of the critical faculty in their contemporaries or the impossibility of their exercising it and not their lack of objective knowledge which led them or tempted them astray. Here we are on common ground. Our own situation in the last century or two curiously resembles that of primitive man. The opportunities for observation, the dragging to light of new facts, has in a measure swamped the processes of logical thought. Analysis of the meaning of things in scientific records has become puerile, and the memory of the facts themselves in this futility of attempt at utilization slips rapidly away from the consciousness of civilized men. If the variation in the aspect of an animal's entrails may not, the conjunction of certain stars in the sky, the phases of the moon, *may*, at least account for certain climatological phenomena, and, perhaps oftener than in our scorn we admit, for certain etiological and pathological phenomena of disease; they may have directly or indirectly much to do in altering the pharmaceutical behavior and the therapeutic effects of the leaves and juices of plants. They may have some sort of relation to the recurrence of the rut in animals, and there may be some coincidence with the mysterious phenomena of menstruation in the human female. If that is so, modern science has not discovered it or has arrived at only a vague adumbration of the connection. They do not impress the modern man, because they do not run in certain channels which his mental faculties are now accustomed blindly to follow without the exercise of reason. When, however, certain modes of *modern* thought are followed in discourses on etiology rational exercise of the mind promptly sinks out of sight. Primitive man, no more than the most recent of modern men, tends to lend to these vague and usually fallacious hints of natural phenomena a significance often entirely illogical and absolutely devoid of rational analysis. He was no more often given to it, perhaps, but he certainly no less fre-

quently allowed his reasoning powers to sink into abeyance, and by social inheritance he had much less material on which securely to exercise them.

We must reluctantly admit this, and to admit it is to deplore it, but to a degree we are also in a position occasionally to admit and to rejoice in the faculty of imagination vouchsafed to man as one of the gifts that differentiate him from the brutes. Inappropriately used and uncontrolled as it often is, the boundless things that appeal to the imagination and the priceless possession of it, and not alone the powers of observation and memory we share with the brutes, are the incentives and indeed the means of human progress. There is something in the appeal of the prophets to higher powers which continues to move the soul of man long after he has ceased to believe in their vaticinations. The forecasts of Isaiah and the Songs of Solomon strike a chord in the emotions of men like Byron's "Apostrophe to the Ocean" and the poems of Ossian. The more direct the contact with these primeval feelings and these forces of nature, the more acutely are the minds of men moved and the more completely are their actions controlled, which is the practical thing for ruler and priest, for prophet and physician. The Indian medicine man invoking the mighty waters to help him in his ministrations appeals to the emotional side of man and the value of it as an adjuvant, or of like things as the very sheet anchor of therapy, can not be overestimated. Yet wherever one studies these incantations, however faithfully they may be transcribed, there is always to us something incoherent about the flow of ideas. Those of primitive men and quite as much those of another civilization jar and weary us. This is not altogether due to our lack of comprehension and sympathy with ideas and an age which has long since passed away and is all but lost to us. We know that our own phylacteries do not bear analysis and we may well believe that such things may have seemed quite as incoherent in the time of Pharaoh as the outbursts of modern emotions when questioned do in our own time. We scoff at the Babylonian prayers. The scoffers at our own have quoted them in derision. Our own are music to the souls of some of us, unbelievers that we are, while around the pillars of our thought they are so entwined for others; they are so incorporated with the fiber of the feelings that most of us fail to see how absurd and inane and meaningless they are in the cold light of analysis. If that is so to-day, why should we understand such things echoing from the banks of the Nile across 4,000 years? But if for a single moment we forget their power of appeal to the emotions of the dwellers along its banks

we shall surely fail to understand the course of the evolution not of history alone, but of medical thought. They are not only a valuable asset in therapy, but they profoundly influenced theory.

Man has never ceased to profit by such musings, by such exercises of the imagination. He gathers his herbs when the glint of the new moon is on them—perhaps at one of the new moons their medicinal properties are more available, but they more often remind him of something associated with the malady as he understands it. His belief and his faith inspires the patient subjectively in as helpful a way as objectively the juice of the leaf has accomplished. He summons the spirit of the rushing waters and he treasures the shining stones they have polished. They fit in with some notion which flits through or finds permanent lodgment in his brain. The association of these ideas we can seldom hope to trace, but we must neither fail to appreciate their power, nor forget the germ of truth which lies concealed, evidenced often by objective results which we are able to grasp. Fetichism and animism and many another manifestation abhorrent to our rational precepts have arisen from such imaginative musings of the physician-priest. He has transmitted them to us in the various forms of superstitions still or lately with us; ghosts, enchantments, charms are still with us or a tradition of them is familiar to us yet. These are but remnants of the earliest forms of beliefs in spirits and demons which took anthropomorphic forms in the deductions of the science of earlier times.

Not only did demons in human shape persist until long after our own traditions participated in the current of human thought, but the theriomorphic concepts of the soul have left traces with us. They go back to primitive man. I have attempted to show elsewhere how early and how widespread in its influence on medical theories was the idea of the soul. The invisible wraith or breath in its flight from the body, like smoke, their imagination pictured so vividly that in the mind's eye they caught glimpses of it as it flew upward. In the stories that have come to us from the primitive Australians and Melanesians, we find them declaring they hear the wings of the spirit of man as it flies aloft on some errand of the tribal wizard. The whir of the pinions announces its return, and the people declared that he whose soul thus flew aloft was found to have sprouted feathers on his body.[6] Now it is not difficult to see the connection of ideas, nor the reason why the affiliation persisted

[6] Smyth, R. B., "The Aborigines of Victoria," Melbourne, 1878, 2 vols.

through the queer feathered bewinged bird bodies perched as the Ba souls on Egyptian tombs, through the foul harpies of Greek mythology, through the lofty conceptions of the soul in Plato's dialogues, to the winged angels of our own Christian cult. The thought started with the fugacity, the evanescent nature of the human soul, it carried well the materialistic burden of Egyptian conceptions, it found ready acceptance in the aspirations of the human soul as Socrates unfolded them to Phædrus under the murmuring leaves of the plane tree on the banks of the Ilissus. The soaring aloft of man's spirit to mansions in the sky in the religion of Christ adapted the primitive, Egypto-Greek mechanism again to an aerial or etherial medium.

It is rarely the case, but it sometimes happens, that we can thus follow the course of human thought from its primitive source in the budding intellect of man through the vicissitudes and cataclysms of ten thousand years to our own day. It is a striking exemplification of the unchanging psychical and mental nature of man that a spiritual environment should have preserved and developed a materialistic soaring on the wing, which the wondering savage daily saw in the flight of birds from the earth to the sky over his head, into the stimulating spiritual thought of the soul of man aspiring to things not of this earth. Elsewhere also I have sought further exemplification of the pneuma, the counterpart or alter ego of the soul, springing from the primitive observation of the advent of death coincident with the cessation of respiration and the stoppage of the breath developing into a theory which created an imaginative anatomy for the Egyptians and a suggestive basis for the etiological and pathological conceptions of Greek medicine. I have tried also to show how the fatal gush of blood from foe or friend, or from the quarry in the chase, created the art of hepatoscopy with the Babylonians and their Etrusco-Roman heirs, and ultimately grew into the Galenic humoral theory. It is not necessary here to repeat the argument which brings out the physiological environment which made possible the persistence of these primitive ideas in regard to the "breath of life" and the blood as "the life," to an efflorescence within at least hailing distance of our own times. Neo-humoral theories are still reminiscent of the blood rites of brotherhood of the African and Australian wild men, which in turn were based on the phenomenon of fatal hemorrhage in man and beast.

I may now turn from these themes, more or less familiar to us all, at least in some of their aspects, illustrative of the en-

[8] *L. c.*

vironment which originated basic conceptions and favored their persistence from the infancy of mankind to an advanced age. It is not difficult to acquiesce in the view that for the few threads we hold in our hands to-day, a million strands have been broken and lost to us in this vast interval of time.

With the racial idiosyncrasies of other races we need have little concern, but it so happens that in the story of the consecutive development of thought the negro and the Greek play for us important rôles. It may be that other races, when we know more of the ramifications of thought and theory which have entered the fabric of our own civilization from them, may exhibit idiosyncrasies as striking as those which greater and more careful study of the black African and the white Aryan Greek have revealed to the student of their ethnography. It has been much the fashion among ethnologists to insist that the mental capacity does not greatly vary, that the cerebral hemispheres occupied as much cranial space ten thousand years ago as they do now, some insist even more. I can not presume to contradict this view of those much more competent than I in the matter. I may, however, seek to circumnavigate a rock in my course, which I can not help regarding with some misgivings and with some inward revolt, by suggesting there are brains and brains, in which doubtless I should receive aid from those more knowing, and by adding that there are also capacities and capacities. I may perhaps leave the question of functional efficiency in the anatomical organization of the cerebral tissue, for that is still and probably will always remain a refuge for those when hard beset who are reluctant to deny the evolution of mental capacity to a higher plane than it occupied in the time of the cavemen. Lord Avebury was of the opinion that, given the same environment, the human mind works in like fashion everywhere, and its results are all but identical.

The negro or negroid race, a very vague term I admit, is one that interests us in this connection not only as a theme to illustrate the basis of belief, but because it is directly in line with our ancestral inheritance of culture and civilization, for the primitive Egyptian and his civilization were not simply African, but negroid, and we through the Greeks are the heirs of its culture. Now, in this country, the contest as to racial cerebral efficiency rages around the negro. Ethnologists for the most part declare that his backwardness in this country is not due to racial inferiority, but to social handicap. The arguments against this view, with which I confess I sympathize, are familiar to most readers, and I do not propose to parade them

here. I prefer to take the view of Miss Kingsley and many others, who have studied him in Africa and who declare he is vastly more spiritually minded than the modern predominant type of white man; but we also have many spiritually minded individuals among us. Spiritually minded people, white or black, set down in a population of an essentially materialistic turn of mind need guardians from the cradle to the grave; so with the negro; with his congeners in Africa he may indeed, as have the Hindus, evolved civilizations and built empires, but the pantheism bred in him by heredity and strengthened by environment, perhaps by selection, has placed him on a poor footing with the materialistic white man in this country. The white man invites him to take a seat at a game evolved by and for the white man. Why indeed should he not fail? It is not his game. Now I do not wish to raise the question whether the white man's game is a better game than the black man's game nor the question of the inferiority or superiority of one race over another, but while I have had little or no experience with other races, I think the black race shows radical mental differences when compared with the white race, and I can not help sympathizing with the view that there is something, not radically wrong, but radically different also in the thinking of the educated white man and of primitive man, though there can be no question that the difference has been, perhaps still is, grossly exaggerated.

In torturing ourselves to be kind and patronizing to the men of other races, in wishing to make them feel complimented by assuring them they are just like us, we assume the attitude of the most egregious and narrow-minded vanity. We tacitly assert that the captain of industry who knows how to cipher and calculate and by means thereof to bully and dominate his fellow man is the highest type of human nature conceivable. We ignore Swedenborg and the prophets, in which class the negro belongs. At different historical epochs the ideal type, as put in the foremost ranks for veneration by the white race—the warrior, the ascetic, the materialist, the idealist, the altruist—has come and gone. Representatives of each class at every epoch are always readily found and have enjoyed their heyday of popularity and have given place to a new admiration. Men differ and so does the mean type of the race from age to age, according to its stage of progress, but to say which is inferior, which is superior, smacks of intolerance and involuntarily we smell the martyr's burning fagots, we hear the chains of slaves and the creak of prison doors, we see the endless line of the

crucified who have not fitted into the general scheme of things. The negro's mind is at antipodes with the Greek mind. It does not analyze, but it believes, with a faith which is entire and absolute, that crude impression which first reaches it through the senses. The negro is emotional not only in sensual fashion, but in a spiritual fashion, and as he once was portrayed on monuments now 6,000 years old so he remains to-day in Africa or in America, but who is there to deny that much which is best in our own civilization had its origin in some man's supreme capacity for spiritual emotion, which the negro has in such a marked degree?

Whether we think it of "low" or "high" mentality, the spiritually minded when pantheism was the universal theory of mankind, were its rulers, and they shaped the infancy of primitive thought. We can, therefore, not be indifferent to Aveburys opinion that "the human mind works everywhere in like fashion"—to deny it is a very different thing from denying that one mind is more practically efficient in our own view as to what is worth while. We are far from being unbiased judges in deciding what is a superior and what an inferior mind. Moreover, the whole form of the discussion is grossly unscientific, because unconsciously we discuss it from a standpoint that is subjective, not objective.

In introducing the Greeks I do not do so to adduce another and a contrasting example of racial idiosyncrasy, though it is a striking one. I do it chiefly to force home the previous argument. All students of the dawn of history—all those who have pried into the practical life and the esoteric life of the ancient oriental civilizations so far as their details before the Trojan war have been revealed to us, feel that with the advent of the northern races around the Ægean Sea something almost cataclysmic happened in the smooth course of the progress of thought and emotional life, in philosophy and art and religion. The strain of adjusting oneself to these things, among the Egyptians and Assyrians is relieved as we look upon the art of Crete and read the dialogues of Plato. The cannibalism of primitive man revolts us scarcely as much as the pæderasty of the Greeks, but ancient oriental thought and emotion estrange us still more. We turn to the northern invader, we whose blood flows from his ancestors in western Europe, and we realize that "East is East and West is West." Why indeed then should we not think that the negro, whose spirit lay so heavy on the brown race that dwelt along the Nile and around the Mediterranean, is an inferior race? We understand the Greek, we are

of his blood, his way of thinking, his religion, so far as he had any. His analysis and criticism, the spirit of his music, his plastic and dramatic art, flowed to us around the northern ends of the Alps before we found him again in the Mediterranean. We look down the paths of the black race and they are dark to us. It seems to me then this aspect of the question, imperfectly exposed as it is here, is an added reason for us to realize that the basis of primitive belief must have been affected not alone by environment, but by the fact that all men do *not* think alike in it either individually or racially.

The psychology of the crowd manifested by beliefs due to no individual process of reasoning, but to contagion, need find no place for discussion here, since they have less to do with the basis of belief than with its propagation. We may more profitably turn to one less discussed in current literature. In a recent book[7] on the ethnology of Africa there is a long and careful description of the art of divination by means of casting bones, the astragalus bones of various animals, domestic and wild. It is a very complex and absorbing occupation—not a child's play at all—but it requires considerable mental concentration, not a common thing apparently among primitive men. The rules are well known to all the tribe, but the mental effort to interpret, *i. e.*, to drag present, past and especially future, events into harmony with its rules and their results, is very great and necessarily at once trains the intellect, and, through the skill acquired, excites the admiration, and, through the concomitant awe and fear of approaching disaster or joy in the anticipation of agreeable experiences to come, makes the expounder and practitioner distinguished. Attention is drawn to this matter by another observer[8] of primitive man in Africa, who declares that the wizards are dupes of their own mental abstractions, their thoughts being based on natural impulses and emotions. The absorption of the attention and the concentration of thought in themselves are entirely sufficient to enlist the faith of the performer in his own assertions and prophecies; he believes in it, just as the doctor or ecclesiastic or the scientist believes in what he is working at, not through its intrinsic value as a method of arriving at the truth, but because it absorbs his attention and diverts it from a study of the environment. It is a hypnosis with the Bantu conjurer in the same sense that the doctor's art, the theologian's belief, the scientist's experiments, are to them.

[7] Junod, Henri A., "The Life of a South African Tribe," London, 1912–13, 2 vols.

[8] Leonard, A. G., "The Lower Niger and its Tribes," London, 1906.

It is Nature's revenge on man, who attempts by earnest fierce attention and energy to wring her secrets from her. She hypnotizes the assailant, or the suppliant, just as the snake charms the bird, just as the hypnotist influences the neurotic and the hysterical. It is the intensity of the preoccupation of the mind of the saint which throws him into an ecstasy or a catalepsy, the very antithesis of the detachment which the knowing seeker of the truth cultivates. He who allows himself to be mastered by his subject may indeed acquire honor and riches, but the thing he seeks eludes his grasp. Usually he passes into the twilight of mental inertia from the soothing effect of the honors and riches upon his sense of critical discrimination. When he becomes incapable of laughing at himself, he is in danger of damnation, and of course excessively disagreeable.

Contagion in the crowd and intensification of application in the cloister are somewhat aside from the basis of primitive belief, but they lie close beside it. They do not necessarily guide it into false paths, but on whatever highroad faith, true or false, is found they accentuate the pace along it. Errors of logic, on the other hand, also lying close to the foundations of belief, alter the direction of faith. Though modern errors of logic are scarcely less flagitious than the ancient, I should be presumptuous indeed if I attempted to point them out.

Hume said there is a universal tendency in mankind to conceive all beings like themselves and to transfer to every object those qualities of which they are intimately conscious. Goethe puts it in the mouth of the supernatural spirit, to whom Faust wished to liken himself, thus:

> Du gleichst dem Geist
> Den du begreifst
> Nicht mir.

This anthropomorphism was as all-prevading in primitive medicine as it was in primitive religion. It is not for us here to inquire whether modern religion has freed itself from this motive or not. Suffice it to say if this was not one of the fundamental motives on which rested the belief of primitive man in magical medicine, it was a fertile source of error in its inception and long continued one of the glaring vices that perverted the logic of antiquity, for anthropomorphism is but one aspect of parallelism. The roots of the Babylonian astral system[9] rest on his view. The continuous sameness of the repe-

[9] Oefele, Felix von, "Janus," XII., 1907, p. 196.

titons of the courses of the heavenly bodies seemed to base its only explanation in a law of parallelism which rules nature and history alike. It was and is a blindness to the true nature of sequences, an ignorance of the laws of chance and coincidence. It is long since this fallacy of logic first dawned on the human intellect, but it is still often persistently oblivious of the falseness of the deduction "post hoc ergo propter hoc." In Babylon the observations of parallels was the chief concern. A fund of wisdom was built up on the basis of the painstaking collection and observation of facts and their sequences. The folly of disregarding the terms of logic was as little heeded then as now. The political, religious, historical events in sequence to certain stellar and cosmic happenings became a matter of voluminous record and unquestioned guidance. Vegetation dying at the conjunction of certain heavenly bodies and springing to life again when other conjunctions supervened through induction of parallels gave rise by deduction to religious and physiological conceptions of resurrection and of life after death, which still actively persist in their theocratic form at least. We see the trail of this sort of reasoning everywhere. It is doubtless very much more the process of the primitive mind than of the modern, but there it is more insistent on our attention, because we examine the mentality of remote generations much more critically and much less sympathetically than our own. I have only alluded to the astrology of Babylon, but the records of observations made on modern primitive men are pervaded with it.

If we can boast that we have almost banished from our scientific processes of reasoning the vices of anthropomorphism and parallelism in most of its other forms, this is not the case with another vice of logic, which I venture to say is quite as prominent in modern reasoning as in that of the cave man. Castelnuova is quoted[10] as saying:

> To an eye more piercing than our own the universe would seem apparently more complex than we imagine it; but fortune has willed that the imperfect senses should fail to reveal to the first observers of the world the great number of anomalies which were apparent later and has constructed, so to say, foregrounds of the picture, each succeeding the other. The building up of present-day sciences would have been vastly more slow if this perspective had failed and the successive observers had attributed the same value to near and far objects.

Now this may be so. The man of the stone age, had he realized the complexity of etiology, might well have given up in despair the project of finding the cause for anything. If it seems never

[10] "Scientia," 1, v, 1916, p. 341.

to have dawned on him that a phenomenon could have more than one cause, it was due to that kind of pantheism which he held to be the state of nature which obeys no law. He looked upon life not as a process, but as a fiat. "Let there be light; and there was light," and that was all there was about it.

Now of course this simplicity of conception is no longer the characteristic of trained and exceptional minds. Lord Kelvin when he wished to explain to himself a complicated question in physics depended upon the imagination of, or on actual construction of, a mechanical model to represent all the factors which influenced the result. A series of pulleys and levers, sometimes to a very great number, each represented to his master mind an object on which to attach a weight or exert a traction which by means of the connecting thread of causation, was acted on by other factors and all combined to give at the end of the series a totality which represented the expected answer.

> By the joint action of a certain temperature, a certain amount of moisture, and a certain miasm, upon an individual of a particular diathesis, who happens to be in a particular state there may be produced the immense complication of effects constituting a disease.[11]

The great philosopher who wrote this sixty-odd years ago may have had his counterpart 6,000 years ago in Mesopotamia, but the vast majority of men then and the vast majority of men now have their minds exclusively fixed on that one word "miasm"—"devils" says the one, "plasmodium or bacillus" says the other. I am not introducing this here because it only disfigured the reasoning that clustered around the basis of belief in the stone age, but because it has failed to acquire that prominence in the discussion of primitive methods of thought which can only be explained by modern as well as by ancient oblivion to its pernicious influence.

If there is such a thing as an innate tendency of the human mind it is that instinct for the conservation of energy which finds its expression in intellectual processes in the endeavor to simplify the contemplation of causality. The common run of men are incapable or stubbornly indisposed to visualize but one of Lord Kelvin's pulleys. Spencer's modifying causes introduce a complexity which pains them and angers them.

[11] Spencer, Herbert, "The Principles of Psychology," New York and London, 1910, 2 vols.

"MAKING THE WORLD SAFE FOR DEMOCRACY"

By Professor CHARLES A. ELLWOOD

UNIVERSITY OF MISSOURI

WHEN Presient Wilson in his War Message to Congress uttered his famous phrase about "making the world safe for democracy," it is doubtful if even he, with all his social and political acumen, understood all that was involved in such a proposition. Certain it is that very few of those who use the phrase so lightly understand. It has become a rallying war-cry, a catch-word to arouse enthusiasm for our doing our "bit" in the war. It would be a pity if it should turn out that this is the only use which we are to make of such a phrase. For surely there is contained in it a program for peace as well as for war; and much more for peace than for war, because the world can not be made "safe for democracy" through war. It is a commonplace with students of social history that war through all the ages has been one of the greatest enemies of democracy. Not only has militancy tended towards the rule of force and towards despotism in general, but even a defensive warfare, such as that in which we are now engaged, has more than once resulted in the subversion of democracy both in government and in society at large. The reasons for this will be plain as we proceed. We wish at this point merely to emphasize that war can never make the world "safe for democracy," and that a much larger program than winning the war is implied in that phrase.

The masses undoubtedly think of democracy merely as a form of government, the rule of the "people." Students of society, however, know that this is only one aspect of democracy and that democracy is to be understood only as a form of social life; that the political phases of democracy rest upon social and moral foundations much deeper than mere governmental forms. Even when conceived as "the rule of the people," the question always remains, "Who are the people?" This question has been answered so variously from age to age that the answers summarize the whole history and trend of democracy. In ancient Greece the "people" were a master

class imposing their authority as a sovereign group upon a population of which from one half to four fifths were slaves, and another very considerable fraction without citizenship rights. From the modern point of view Greek democracies, so-called, were not democracies at all, but were authoritarian, despotic societies, ruled by a very small oligarchic or aristocratic class. Throughout our own history, indeed, the definition of who constitutes the people has been so narrow that only a very small fraction of our population has had any actual share in the work of government. Slaves were excluded from our conception of the "people" until the Civil War, and women until very recent times.

On the other hand, in primitive times, modern anthropology tells us, as among some existing savage and barbarous peoples, there were democracies in which the "people" included all the adults recognized as belonging to a particular group. In these primitive democracies, such as those of many North American Indian tribes, clan and tribal assemblies or councils decided all matters pertaining to the group as a whole; and in such assemblies not only the men, but also the women, had a voice as a rule. There were two outstanding features of these primitive democracies, however, which sharply differentiate them from democracy as we think of it in the modern world. Majority rule was practically unknown among them but every decision which they reached regarding group action had to be a practically unanimous decision. This rule of unanimity made the the primitive democracy static, non-progressive, or at least very slow to make changes. Hence the second feature of their life which differs from ours was that democratic control with them was almost wholly the control of custom and tradition. Intelligence, after all, had a very small part to play in such habit-ridden communities.

Modern democracy is accordingly something quite unlike its classic and primitive prototypes. Democracy in classic antiquity was really aristocracy or oligarchy; in primitive times it was simply the rule of custom in a group of sympathetically likeminded individuals. Unlike ancient democracy, modern democracy is unwilling to recognize any subject or servile class, or indeed any class of adults who are excluded from political privileges. It rests rather upon the recognition of the potentially equal social worth of all individuals. Unlike primitive democracy, modern democracy does not rest upon the *customary* similarity of habits, feelings and ideas of the group, but aspires rather to rest upon the *rational*, intelligently formed

judgment of every normal adult individual in the group. It is a serious sociological error to confuse the various types of social life and of government to which the term "democracy" has been applied. Modern democracy, it is evident, is a wholly new stage of social evolution, and may truly be called "the great adventure" of our civilization.

The various stages in the evolution of social control will make plain to us the nature of modern democracy, and why it is the great advanture of the modern world. A review of these stages will show, in other words, the exact significance and nature of modern democracy in relation to social evolution. The lowest form of social control of which we know is that which rests upon instinct and upon the correlated selective processes of the natural environment. Such social control, if such we may call it, is characteristic of animal groups. But the lowest human groups of which we have knowledge show a very different type of control—that of habit, of custom and tradition. All existing savage communities of mankind show this type of control and we have every reason to believe that it represents the primitive human social condition. It is the type of social control which we find in the primitive democracies just mentioned. The control exercised by them was through the sympathetic and formal likemindedness which rested largely upon the sentiment of kinship; and hence the organization of such primitive democracies was of the simplest sort.

A third form of social control is that in which the control is exercised by the despotic power of a small group of individuals over a larger group. This control sprang from the conquest of one group by another. After the conquest and subjugation of one group by another, of necessity some sort of machinery of government had to be elaborated in order to establish and maintain the unity of the whole population. Centralized control in the hands of definite authorities became inevitable. Under such circumstances the war chief usually developed into a king, with his authority more or less limited, however, by the council of the conquering tribe. In many cases despotic forms of monarchic government gradually developed; but in some groups the tradition that the freemen of the conquering tribe were the source of authority persisted, and after the subjugated elements had become reconciled to their position as slaves, the former drove out their kings and distributed authority again democratically among themselves. Thus arose the spurious "democracies" of classic antiquity. They were democratic only with reference to the members of the conquer-

ing class. In essence, however, they were authoritarian societies, since the ruling class maintained its authority and the unity of the whole population through a fear-inspired obedience. Their utter unlikeness to modern democracy is evident. They belonged to the authoritarian stage of social control and of social evolution.

Authoritarian societies of one sort or another, whether styled "democratic" or "autocratic," have characterized the greater part of the history of western civilization from the earliest times down to the present. The most prominent national groups of the modern world until very recently have been of this type. But within the last one hundred years or so a fourth and higher type of social control has been gradually emerging in the most advanced nations of western civilization —a type of control in which the unity of the group is secured not through custom and tradition based upon the sentiment of kinship, nor through coercive authority, but through the intelligent purpose and will of the whole population. We may call this new type of social control "free society" in contrast with the custom-ruled and the authoritarian societies of the past. This is modern democracy. In essence it is a form of social control in which the untrammeled opinion and will of every adult member of the group enters into the determination of group behavior. As Hobhouse says: "It founds the common good upon the common will, in forming which it bids every grown-up, intelligent person to take a part."[1] It is much more, therefore, than a form of the state or of government. It is rather a new phase of social evolution, a phase which attempts to reconcile individualism and collectivism. Social control of some sort in every complex human group is necessary; but democracy would admit to a share in that control the wills of all the adult members of the group who show any intelligent interest in the control of the behavior of the group. Evidently there is a reason for calling democracy in this sense "free society." Evidently, also, it is a new experiment in the world's history, the nearest approximation being those primitive democracies of the past which were ruled essentially by custom and swayed by sympathetic rather than by rational likemindedness.

It is now evident why democracy, in the modern sense, is at once the hope and the great adventure of our race. It is the hope of mankind, because it is to groups what self-determination and self-realization are for the individual. It represents, if it can be successfully achieved, nothing less than the final phase of social control and of political evolution, the goal

[1] "Liberalism," p. 228.

toward which all human history has been striving. On the other hand, it is an adventure, because its success obviously depends upon the possibility of vast masses of men forming rational opinions and executing rational decisions as a group. Now this is only possible when there is adequate machinery to develop rational likemindedness and a rational will in the group as a whole.

Democratic society, in other words, must find a means of selecting among all the possible opinions which the members of a large group may develop the most rational opinion and of basing group decision and group action thereon. Modern democracy depends, therefore, upon free thought, free public discussion, a free press, free assemblage, and free selection of public policies and public leaders; for if we do not have free thought and free public discussion before a policy is entered upon, we cannot have that process of mutual education by which the most rational ideas are brought to prevail. Intercommunication, according to psychology, is a method of reciprocal adaptation between individuals; and as soon as freedom of thought and of public discussion are abridged the whole machinery of adjustment in a group will be hampered—it will be impossible to compare ideas and to come to a rational judgment regarding group policies.[2] In other words, it is only through free discussion and the formation of a public opinion, untrammeled either by the prejudices and emotions of the whole group, or by the interests and power of some special class, that democracy can be a safe and efficient means of social control. In democracy, then, it is public opinion which is the force that lies back of the power of all regulative institutions; and democratic society can be efficient and successful only in proportion as it succeeds in making public opinion rational and powerful.

Some of the difficulties of democracy, as a means of social control in the great complex societies of the modern world, now become manifest. For, how can we secure in such societies the free formation of a public opinion, which is at once rational and powerful? The day of government by "town meeting," or the formation of rational opinion through face-to-face discussion in a public assemblage, is past forever. In great groups, numbering millions, the press must necessarily be the chief means of intercommunication and public discussion; accordingly, it is upon a free and untrammeled press, yet one controlled by a high sense of social obligation, that the formation

[2] For elaboration of this point, see Chapters VII. and VIII. of the writer's "Introduction to Social Psychology" (D. Appleton & Co., 1917).

of a rational public opinion depends. The press to be efficient must represent all shades of opinion in the group. If the press is in the hands of a single class, or of a few corporations, it is almost bound to fail to represent the opinions of all classes and sections. Even more would it fail if it were under the control of one socialistically organized government. Socialism, thus far, has not grappled with the problem of a free press in any convincing manner. Newspapers, periodicals and books published and distributed by the state would be very far from a free press. Yet free public criticism is the very breath of life of that "free society" which democracy is supposed to represent.

Another difficulty of democracy, especially as a form of government, is that in modern societies it can not proceed upon the basis of unanimity, but is forced to adopt the principle of "majority rule." The decisions which democratic governments reach, accordingly, can usually be, even under modern methods of "direct" government by the people, only decisions reached by a majority. In nations consisting of millions it would be foolishness to contend that any social will had been formed when a bare majority had decided some social issue. At best, such a decision is but a temporary compromise. Definite social choice has not really been reached, and hence the whole situation remains unstable. But unity of thought, feeling and will is necessary for successful action in a group. Of course it is easy to exaggerate the dangers of bare majority rule; but there can be scarcely any doubt that a great deal of the inefficiency of democracies in the past, of their lax enforcement of law, and of their internal dissensions, is due to this fact. Further discussion and a more fully developed social consciousness regarding the situation are evidently what is needed, in a majority of such cases, to obtain a social decision which is truly representative of the will of the group. The safety of modern democracy, accordingly, depends upon employing every means of public education which will fully arouse the consciousness of the group regarding any given social situation. And this, again, depends upon freedom of intercommunication and of public discussion.

Another difficulty of democracy here comes into view; and that is, how far is the control exercised by the majority to go? If it goes so far as to suppress free opinion, free speech, and free discussion, evidently it is in danger of undermining the very basis of democracy. Rather democracy, in any intelligible sense of the word, is already destroyed when free thought, free speech and free discussion in a public press are suppressed

prior to the making of a social decision. But even in the case of decisions made by a majority, the possibility that the decision fails to represent the will of the group, or that it may be a mistaken decision, makes it important that free thought and free speech shall be preserved after a decision is made. Real democracy can only be safe when a minority has the right to try to convert a majority to its views by using all rational means to show that a social mistake was made. Hence the rights of majorities in true democracies can never be "absolute." There can be no absolute government in a true democracy, therefore, despite Rousseau's argument to the contrary. In practise modern democracies have not attempted, as a rule, to exercise control over the opinions, beliefs and practises of the people in many matters, as, for example, in religion. It is time that the myth of the absolute sovereignty of the state or government were exploded. Such a myth under autocracy may be very useful, but under democracy it is bound to be dangerous. It is time, therefore, that all modern democracies recognize that their principle is "limited majority rule" rather than "absolute majority rule." But the dogma of absolute majority rule prevails in most modern attempts at democracy, and perhaps nowhere more than in America. Under absolute majority rule freedom of thought, speech and conduct is bound to be lost; and democracy will turn out to be nothing more than the tyranny of a majority, which in order to maintain itself will seek refuge more and more in autocratic principles and practises.

It was perhaps the perception of this danger which led our forefathers to adopt the maxim, "that government is best which governs least." But we see that this principle of non-government is also dangerous to democracy, more dangerous perhaps, than the exercise of an absolute and rigid control by a bare majority. If modern social science has demonstrated anything in a practical sense, it has demonstrated that social control must extend over all of the activities and interests of life. The doctrine of *laissez faire* is dead because it will not work as a practical policy under modern conditions. We now see, as Mill said, that the function of government, as an agency of social control, is "coextensive with human interests." However, if government is going to embrace all human interests, and if democracy is the free formation of a social will out of all individual wills, it is evident that there must be a high development of intelligence and character in the individual citizen if democracy is to be "safe for the world." The individual citizen must understand the social consequences of bad industrial

conditions, bad sanitary conditions, poor education and corrupt living. But the democratic control of social life through governmental agencies is necessarily limited, in its direct action, to relatively *external* conditions. This being so, and democracy being dependent upon the freedom of the inner life of the individual, it is evident that *the success of democratic governmental control will depend not so much upon governmental coercion of the individual as upon eliciting his spontaneous initiative and intelligent cooperation.* A democratic government, in other words, to be successful, must represent the spontaneous and intelligent cooperation of the whole mass of its citizens in what Aristotle called "well-living." Strictly speaking, it is not a government at all in the old-fashioned, authoritarian sense of the word. It is rather the free, collective control of the whole group over the conditions of its own existence.

Under what conditions can democratic control over the conditions of collective existence be successful? Manifestly, only when there is a good degree of intelligent likemindedness in the population as a whole. No one has perhaps stated the matter better than Professor Giddings. In answering the question, he says:

> Upon what basis have free communities risen and flourished? Always this: the people that have made them and maintained them have been sufficiently likeminded, sufficiently alike in their purposes, in their morals, in their ambitions and ideals, in their views of policy and method, to work together spontaneously. Naturally there has been among them what the old Roman lawyers called "a meeting of minds," so that without a whip over them, or a strong hand to hold them together, they have collectively carried on the struggle for existence and advantage, freely and effectively. They have all seen the same truth; they have all wanted the same success, they have striven by the same method for the realization of the same great purpose.[3]

But the old sympathetic and formal likemindedness which sufficed for primitive democracy will not work, as we have seen, under modern conditions; modern democracy can depend only upon *rational* likemindedness, and indeed it aspires to rest upon nothing less. But rational likemindedness depends upon the education of the whole body of citizens with reference to social and political matters. To be a success, then, modern democracy must educate the whole body of citizens in knowledge of social situations and in a sense of social obligation. Especially, must citizens be trained in the knowledge and art of self-government. This educational process should take place largely, of course, in our public schools; but every edu-

[3] Quoted by Professor Newell Sims in his "Ultimate Democracy and Its Making," p. 72.

cational institution, such as the home and the church, should also do its part; and this social education must be continued throughout the adult life of the individual by the press and by free discussions in public assemblages and in "social centers." For only when there is a proper diffusion of social knowledge among the masses and an adequate inculcation of the sense of social obligation can there be developed such a rational likemindedness as to insure the success of democracy. The whole people, in other words, must be kept in a state of continuous learning regarding social matters. The social sciences must be developed and given first place in the curriculum of our schools, and the mutual education in social matters which comes through the public discussion of social policies, either in the press or in public assemblages, must be encouraged in every way. One can not but remark here upon the foolishness, not only of placing restrictions upon the freest formation of rational likemindedness and public opinion, but also of needlessly complicating the situation in communities struggling toward democracy by introducing illiterate elements, or those who through race, language or tradition are incapable of becoming rationally likeminded with the rest of the community. If such there be, a too widely open door for such non-assimilable elements must make democracy unworkable.

The problem of democracy must not be discussed, however, too exclusively from the standpoint of government. In its essence, as we have seen, democracy is a form of the social life in general, and not simply of government. Nothing could be more opposed to democracy than such hopeless poverty as prevents the normal development of intelligence and character in citizens. As Hobhouse says, "People are not fully free in their political capacity [even] when they are subject industrially to conditions which take the life and the heart out of them."[4] There are other reasons, as we shall see, also why a form of industry which breeds poverty is essentially opposed to democracy. But as a form of social control democracy relates as much to the other institutions of social life as it does to the state and government. Democracy in the state and in government can not long succeed, indeed, unless democracy runs through the whole of the social life. We are beginning to see that a feudal or autocratic industry is a menace to democratic politics. We are also beginning to realize that the family, the school, the church and even "polite society" itself must be democratized if we are to maintain democracy in the state. Consequently, in the family life we find the old authoritarian

[4] "Liberalism," p. 249.

family to be passing and a more democratic type of the family to be evolving. A larger and larger measure of democracy is being introduced into our churches, even though older forms of ecclesiastical organization may persist. Our schools are at least beginning to try out the principles of self-government. Most of our "free associations" are striving to organize themselves democratically, while in the most intimate personal relations of social life the most advanced peoples are seeking to realize democratic ideals.

Now it is in these smaller groups, in the more intimate relations of social life, that the real nature of democracy comes most clearly into view. In these relations democracy has been slow to develop because in them democracy is seen to be something more than a mere form of relationship among individuals. It is seen to involve a social and personal attitude of individuals toward one another. This attitude is not that of absolute liberty or pure individualism. Such individualism and such liberty are the negation of social control. They lead inevitably to the exploitation of the weak by the strong and to anarchy in all of the relations of life. Democracy does not mean, then, the emancipation of the individual from social control. It is rather, as we have already said, a form of social control which attempts to reconcile the inner, moral freedom of the individual with the needs of objective social life. To accomplish this it must necessarily be careful to avoid the destruction of the sense of social obligation by the inculcation of pure individualism. The liberty for which democracy strives is therefore relative to a deeper principle.

Neither is the social attitude which democracy implies that of absolute or dead-level equality. Such equalitarianism destroys the efficiency of social control, because it prevents that coordination of the group in action, that superordination and subordination of individuals which is necessary for efficient work on the part of the group as a whole. It is often said that the spirit of democracy is essentially opposed to the existence of classes. If by classes are meant privileged castes, then there can be no objection to such a statement. But if by classes we mean simply the necessary divisions in society for the performance of economic, political or cultural tasks, then classes are no more inconsistent with democracy than organized social existence itself. Even a football team must divide itself into classes, or various specialized groups of players, in order to act efficiently. Any social group, indeed, of any size which accomplishes anything must differentiate itself into classes. Only the democratic spirit insists that these class groups in society

at large shall not be artificial groups, but, like the class groups in the football squad, based upon individual merit and fitness. The classes in a democracy should greatly make, therefore, for social efficiency, rather than tend to lessen it. Absolute or dead-level equality, on the other hand, while it might temporarily gratify the egotistic feelings of those whose capacity and ability fit them only to play the part of "scrubs" in the social team, would destroy social efficiency, and so destroy the possibility of democracy becoming a success in a world where efficiency counts. Absolute or dead-level equality is, indeed, more in harmony with certain forms of autocracy than with democracy.

For these reasons the more careful writers on democracy have generally repudiated absolute liberty and absolute equality as dangerous to democracy. The liberty and equality which democracy inculcates are both relative to its fundamental principle, which, for lack of a better term, we may call "fraternity." By fraternity we mean such sympathy, understanding and good will among the members of a group that what they do collectively represents the uncoerced will of all—a spontaneous expression of the inner psychic unity of the group, or at least of a majority of its members. The liberty and equality of the members of a family group or a neighborhood group, for example, are not to be secured through the formal acceptance of liberty and equality, but only through the likemindedness, sympathy and good will of all the members of the group. Then such liberty and equality as is consistent with the total welfare of the group will emerge spontaneously. We now see why democracy is slow of realization in the general social life, while it has been so readily taken up as a form of the state or government. A doctrinaire democracy is possible in politics; but democracy will scarcely work in the face-to-face groups of men, such as the family and the neighborhood, unless it rests upon the social attitude which we have just called "fraternity."

If we are to have a democratic form of industry, for example, we shall not be able to get rid of such fundamental classes as "the chiefs" and "the people," or "the intellectuals" and "the manual workers," any more than the football team would be able to get rid of its captains, half backs, and full backs. But industry would have to be so organized that it would serve the welfare of the whole group. There would be need of such collective control of industry that the opinion and will of every individual in the group would count in the determination of industrial policies. There would have to be fraternity in the management of industrial enterprises and in the

industrial life generally. Consequently, there would also have to be equal remuneration for equal service, and a democratic participation of the workers in the management of every industry, but not to the exclusion of the public which it serves. Whether such industrial democracy implies complete government ownership or not, we need not here discuss. It is sufficient to point out that many socialists have found their chief hope for the coming of socialism, not in democracy, but in working-class supremacy or dominance. Socialism has existed in many forms of society in the past which were not democratic, and the fact that the revolutionary socialists of the present are not inclined to wait for the coming of socialism through the peaceful working of democratic machinery is perhaps even more significant than that some prominent socialists have recently repudiated representative government and declared that socialism will depend for its successful development not upon a democratic, but upon a bureaucratic social and political organization. Fraternalism in industry, however, can not tolerate the individualistic and predatory tactics which we now find only too often in our business world. The menace of such practises to the spirit of democracy does not need to be enlarged upon.

We now see that democracy is a spirit more than a mere form of either government or society. It is a stage in the evolution of the social mind and of social control—that stage which is characterized by the liberty and equality which spring from fraternalism, the recognition of the social worth and brotherhood of all men. Inasmuch as the democratic spirit is unwilling to recognize the artificial distinctions created by class, race or cultural condition, we see at once that modern democracy on its ethical side is practically synonymous with that movement in ethics which we know as "humanitarianism." The safeguarding of democracy demands above all the growth of rational humanitarianism; for as soon as any individual, class, nation or race sets itself up as an end in itself apart from humanity, we must have domination, exploitation and so oligarchy or autocracy. The growth of class, national or racial interests at the expense of the interests of humanity is bound, therefore, to defeat democracy in the long run. To this extent democracy in any given nation is bound up with the triumph of internationalism. Only as we develop and maintain equality of right and of freedom among nations, as Condorcet long ago, and President Wilson recently, said, is democracy safe. As soon as one nation or one class begins to deny the rights of another nation or class it has left behind the spirit of democ-

racy. For this reason democracy is essentially opposed to the rule of force and is trying to put an end to that rule. The great justification for this war is, as President Wilson shrewdly saw, to put an end to the rule of force and to the violation of right by aggressive might.

In other words, peace, social and international, is necessary for the safety of democracy. It has long been remarked that democratic governments are built for peace, not for war, and we now see why this is so and why war of any sort, whether international or civil, tends to the destruction of democratic government. If democracy depends upon sympathy, understanding and good will, nothing can safeguard it like the peaceful development of civilization; for it is only the peaceful development of civilization which can make for the extension of that rational likemindedness which comes through science, and that good will which comes through humanitarian ethics and religion. The great enemies of democracy are those who, whether in the name of class or nation, destroy peace and good will among men to promote their own interests.

It is now evident also why both extreme conservatism and revolutionary radicalism are foes of democracy. Conservatism wishes to preserve institutions of the past which are no longer adapted to the present. They hamper the development of some section of humanity. To maintain them under such conditions becomes a rapidly growing injustice, and injustice, long maintained, destroys good will, and so the basis for social peace. On the other hand, revolutionary radicalism refuses to wait for the peaceful development of civilization to redress real or fancied wrongs. It invokes the immediate use of force, at least as soon as the opportunity is favorable, and so destroys good will. In practice, both extreme conservatism and revolutionary radicalism are accordingly found destructive of democracy. Only a rational progressivism in social and political policies will harmonize with the true spirit of democracy. "Liberalism" is perhaps the nearest single term that we have to describe this rationally progressive spirit.

It may be said that the picture which we have drawn of democracy makes of it an impossible social ideal, and that to "make the world safe for democracy" it would have to become a Utopia. If by this is meant that the world can be made safe for democracy only through the development and perfectioning of humanitarian civilization, we would accept the criticism. But it is no impossible Utopia, no impossible development of civilization, which we have pointed to. Rather it is simply the development of that spirit of rationality and good will in all

phases of collective human life which civilization at its best has always made its aim. To say that the fate of democracy is bound up with the fate of higher civilization ought, indeed, to be regarded as a truism. Two difficulties, however, do present themselves, which need yet to be cleared up. One is the old objection to democracy, that it presupposes a higher development of intelligence and of rational judgment than what the mass of individuals, even in the highest civilizations, are capable of. The other is the objection that if democratic control means only limited control over individuals we can never have social efficiency under democracy.

It may be pointed out that both of these objections fall to the ground as soon as we understand the real nature of democracy; that democracy does not preclude leadership or the highest degree of cooperation with leaders. Doubtless the mass of men can never be trained to be experts in the work of government or in social control generally; and such work, it may be admitted, in order to be efficient must always be done mainly by experts. But all the individuals of a free or democratic society can be taught to select their leaders upon the basis of adequate social knowledge and with patriotic and humanitarian rather than selfish or class ends in view; and they can be taught to coordinate their activities efficiently with the activities of their self-chosen leaders. Democracy does not necessarily mean, therefore, the control of ignorance and mediocrity, as Lecky charged, nor does it mean any necessary lack of social efficiency. The intelligence of a democracy can represent the highest intelligence of which the leaders it evolves are capable. Only it is evident that democracy, in order to be intelligent, must devote itself to the work of training social and political leaders as well as to the general diffusion among the masses of social and political information; and modern democracy has evidently not yet fully awakened to the importance of this matter of training its leaders. With trained leaders, and with the masses at large trained to take the social point of view, and to work cooperatively with their fellows, there is no reason why democratic societies should not be as efficient socially as authoritarian societies. Indeed, in the long run when the masses have been taught to play the social game and to play it well, they will be more efficient—just as the football team in which every member of the team knows so well how to play his part that he does not need to wait for directions from his captain is more efficient than the team in which every member waits upon direction from above before he plays his part.

SCIENTIFIC MANAGEMENT SIMPLIFIED

By MALCOLM KEIR, A.M., Ph.D.
UNIVERSITY OF PENNSYLVANIA

A POTTERY manufacturer of East Liverpool, Ohio, once said to me,

"I can't use scientific management in my plant, because pottery making is so utterly unlike a machine shop. We use power machinery only for mixing our clays, flint and feldspar; all the rest of our operations are hand jobs. I suppose scientific management is a good thing for those fellows in the metal trades that can employ it, but my business is different."

Almost identical opinions are expressed by textile, leather, and paper manufacturers, publishers, office managers, butchers, bakers and candlestick makers. Each claims his business is too "different" to permit scientific management, but all agree that it may be practicable in machine shops. As a matter of fact there are few activities that could not profitably make use of the principles of scientific management. Why then is there so much misconception and confusion in regard to its adaptability?

The answer lies in the history of the movement; since it arose in machine shops, when the leaders published accounts of their efforts they used illustrations drawn from their experience. Men quite naturally supposed scientific management was suited only to the business from which all the examples were taken. Furthermore, most of the writers upon the subject were practitioners rather than expounders, with the consequence that they confounded practices most bewilderingly with principles. Yet these latter are few in number, easily understood and of almost universal application. The fundamental elements of scientific management are standardization, exact knowledge, functionalization, incentive and selected personnel.

Since standardization is the most elementary principle it was first attained, and to-day is the primal step in the installation of scientific management. Upon the success of standardization depends much of the achievement wrought by the remaining principles.

The idea of standardization is easy to conceive, and its util-

ity is readily accepted, yet when you attempt to apply the idea, you have entered upon a long nerve-racking, prejudice-smashing job. To standardize thoroughly may take two or three years and cost you your reputation for sanity. The designs of the product must be reduced to the fewest types; the raw materials must be limited to the few best suited to the purposes; the methods of storage must be subjected to uniform conduct; the entire equipment, including buildings, machines, tools, appliances, work places, light, heat, ventilation, power and the like, all must conform to the few best predetermined models; and finally the product itself must comply with fixed specifications. These general fields of standardization blaze the way for more minute studies. If a man never goes further into scientific management than taking this first step his reward will be great, for standardization pays generous dividends. There is hardly any activity that can not gain in effectiveness by the application of this principle.

After standardization as a fundamental in scientific management comes exact knowledge. As a whole, American business is run by guess; the employees act by "rules of thumb," while the employers govern their work by customs, previous records or a reliance upon "luck." From top to bottom no one has information scientifically determined. The chief reason why such haphazard methods do not wreck business is that all competitors are tarred with the same stick. In the place of "rules of thumb" a thorough investigation of the work should be made. This may involve motion study, fatigue study and time study; analysis of materials, equipment and environment; research into the laws of health, psychological experiment and community improvement. In short the effort to obtain exact knowledge may embrace a use of physics, chemistry, physiology, psychology, sociology and a few more "ologies." Yet when completed, guess work is eliminated and the work proceeds along definite assured lines.

With exact knowledge in regard to the work the employer can base his decisions upon statistics, the most important of which are found by cost accounting. Accurate determination of costs is a prime essential in deciding a business policy. Nevertheless, according to the Federal Trade Commission ninety per cent. of American corporations have no adequate cost data. Other business facts can be tabulated, put in the form of graphs, with the significant features plainly marked and then used to guide the judgment of the men who control the concern. Knowledge takes the place of "luck" in deciding

the fate of a business and success becomes far less of a hazardous gamble.

When any establishment has standardized and obtained an exact knowledge of its affairs, then it is ready to consider the third principle of scientific management; namely, functionalization.

Functionalization is the application to management of the old idea of the subdivision of labor. Executive work ordinarily complex may be simplified by analysis. It consists of clerical, directive, decisive, formulative, disciplinary and selective tasks; it involves the writing and signing of documents, the giving of orders, the judgment of questions affecting the business, the planning of work and sales, the hiring, firing or fining of employees and the picking out of policies or methods. This is the outline of a hard job, but no one task is extremely difficult in itself. If there is enough of any one of these tasks to keep at least one man constantly employed, secure an individual to perform this function. By concentration upon it he can be more effective than a dozen officials who give it only a part of their time. Functionalize and then hold the functionary responsible. This rule applies to all parts of a working staff from the president to the janitor. Let the president do the one thing he is best equipped to perform, and hire a janitor for each type of janitorial service if there is enough work in that type to keep a man constantly busy. A functionalized presidency would consist of several associated presidents, one for clerical, one for directive, one for formulative work and so on. A functionalized janitorship would be made up of sweeping janitors, window-washing janitors, toilet-cleaning janitors and the like. Functionalized foremanship would include instruction, speed and repair foreman. Functionalized planning would involve instruction clerks, route clerks, time-card clerks and whatever others were necessary. Since no two businesses operate with exactly the same functions there can be no rule as to the way functionalization shall be accomplished; one concern would have one set of functions performed by functional officers while another even in the same line of business might show an entirely different line-up. Yet both would illustrate the *principle* of functionalization and that principle is an essential feature of scientific management. The subdivision of the labor of management is fully as important a step in progress as the subdivision of the direct labor of production.

It is unprofitable to spend the money needed for functionalization, exact knowledge and standardization, unless greater

productivity is obtained. In order to insure increased production scientific management sets up "incentive" as the fourth principle. High wages give the workmen the spur needed to induce them to quit loafing on their jobs and to turn out more goods.

The wage systems adopted by industrial engineers usually consists of two parts: a base wage and a bonus. The base wage is customarily the same as the prevailing rate for the work in the community, while the bonus is a percentage of the base. The bonus is paid only to those men who complete a task so fixed that it ordinarily involves an output two or three times as great as prevailed before the installation of scientific management. It is possible to complete this task because by standardization, exact knowledge and functionalization the variety of work required of a man is greatly reduced. The greater output lowers costs per unit, and this gives rise to greater profits out of which the bonus wage is paid.

The establishment of a base rate is seldom scientifically done since the current day rate is accepted without investigation. The percentage allotted to bonus has been made the matter of extensive analysis, and there are at least six methods now in vogue. Some plants use several different methods according to whether the work embraces brawn or brain or combinations of these two.

The working out of the wage system is a matter of detail that need not concern us. The principle involved is that wages shall be sufficiently higher under scientific management than under ordinary management to constitute an incentive for the best workers to seek the plants where scientific management is in use, and to encourage the men employed under it to put forth their best efforts.

In addition to high wages scientific management uses as an incentive the hope of promotion. Railroad men boast that a track walker may become the president. In this respect every other business might profitably pattern after the railroads. The chance to improve one's position is oftentimes a more potent instigation to good work than high wages; especially with young, unmarried employees. Men crave power and will exert themselves if they have any hope of attaining it. Here then is a trait to which scientific management may cater.

Incentives and standardization have been more completely developed as principles of scientific management than exact knowledge or functionalization, but all four until recently had received far more attention than the fifth principle, selected

personnel. Since no man can work at his best upon uncongenial tasks, an industrial misfit causes a loss to the individual concerned and also to the firm that hires him. Scientific management aims to eliminate this double loss by a careful selection of employees. If it is necessary to secure the right materials and handle them in the right ways, it is also requisite to obtain the right men. Each applicant should be analyzed as to his fitness for the occupation he seeks, and every job should be studied as to the type of man it requires. Even such matters as the repulsion or attraction of the temperament of the foreman in reference to the temperament of the applicant should be given consideration. Then hiring and firing should be thoroughly functionalized. The department that selects employees may also be responsible for their training, welfare and betterment. If all questions in regard to labor are thus centralized a real labor policy may be adopted and carried out, much cross-purpose hiring and firing eliminated, and the right men secured for all positions. Much of the friction between the employer and employee may thus be removed.

In summary the principles of scientific management may be expressed in eight words: standardization, exact knowledge, functionalization, incentive and selected personnel. A man who comprehends these principles understands scientific management. Their use is not limited to any one industry but may be applied to almost all activities with what detail the circumstances demand. Railroads, steamship companies, city governments, public service corporations, department stores, banks, publishing houses, professional work, all have made use of the principles described, as well as industrial plants. There is little reason why they can not be further extended to other work. If the principles are grasped, then practices can be adjusted to suit the conditions of each individual case.

CHEMISTRY, A TRADE OR A PROFESSION?

By Professor HANOR A. WEBB

GEORGE PEABODY COLLEGE FOR TEACHERS

The Question Asked.

With the god Mars as his press-agent, the chemist has recently been advertised until a wave of interest in his occupation has swept over the country. Young men, young women, and especially their ambitious parents, are asking us with ever-increasing frequency, "What is a chemist?"

The Problem Studied.

That this question might be answered more intelligently in connection with local conditions, a survey of the chemical industries of Nashville (exclusive of educational institutions) was begun, especial attention being given to the amount of chemical knowledge and training required of the workers, together with their opportunities for advancement along chemical lines. Conversations were had with workers and executives, and statistical data recorded on a suitable questionnaire. Many helpful suggestions were received from Professor R. W. Selvidge, department of industrial arts, George Peabody College for Teachers, based on his past experience in certain extensive government surveys.

Nashville is a city of over 150,000 population, with diversified manufacturing interests, which, at the time of this survey (winter of 1917–1918), included no overshadowing industry. The many plants visited may be grouped into 22 different types, each employing some chemical process, or operating under chemical control. It is likely that similar plants and conditions would be found in almost any city of similar size.

Two Schools for Chemists.

Some chemists go to college, others only to "the school of experience." Ten types of industries in Nashville employ the college man exclusively—nine use the man with "experience only"—in three types are both classes at work. Only two workers were found who had studied high school chemistry but no further—the nature of their work, however, placed them in the "experience only" group.

Choosing Between the Trained and Untrained Chemist.

The employment of a trained chemist depends principally upon two conditions:

1. The size of the plant. The prime function of a chemist, in controlling the operation of a plant, is to effect economies in the process. If it be true that large plants have large wastes, then smaller plants have smaller wastes in the rough proportion of their respective sizes. A plant may be so small that it is cheaper to run wastefully than to employ a chemist.

2. The attitude toward "passable quality." Much of the production observed during this survey was obviously intended for consumers with whom quality was a secondary consideration. It is undoubtedly legitimate to attempt to supply this demand. Such products need not be carefully standardized and there need be but little variation or improvement in the method of manufacture. There is, indeed, little incentive to the manufacturer to improve the quality of his product, especially if it means added expense, with no corresponding increase in selling price advisable.

None of the plants visited in this survey, in which men with "experience only" were employed as chemical workers, were of great size. But whether size made scientific management possible, or whether scientific management would produce the size, was never wholly settled by my discussions with executives.

A Comparison of the Workers.

Discussion, questioning and observation furnished a basis for a comparison of the advantages and opportunities of the workers of each group.

I. *Advantages of the Man with College or Technical School Training, Plus Experience.*

1. He can judge the efficiency of newly suggested processes, without costly experimentation. The history of industry is full of examples where men have wasted great amounts of time and material in trying to determine a formula or method by "trial and error." The trained chemist will at once detect anything which is fundamentally wrong with a new plan.

2. He can change to new methods and formulae with little confusion. No change is absolutely new to the trained chemist. He will also be able to distinguish between changes which are fundamental in the process, and those which are accessory only.

3. He can test, purify and utilize crude materials. Crude materials are never uniform, and wherever used, definite quantitative analyses are necessary. It often happens that very small amounts of certain impurities are exceedingly deleterious to a process, and just as frequently, large amounts of other impurities are of no significance. The trained chemist will know the proper methods of treatment in each case.

4. He can originate new processes and products, especially in the utilization of by-products. The spirit of research is always present in the work of a trained chemist. He has had opportunity to realize the enormous mass of chemical knowledge, and the view which he has taken of the breadth of the science has greatly widened his horizon. He is able to more clearly judge what additional products may be needed in his field of manufacture, and what materials will serve.

5. He profits rapidly and extensively from experience. A fact learned in experience is immediately measured by a principle learned in theory, and the fundamentals and accessories of a process properly judged. Related phenomena are connected with each other, no matter how different they may appear.

6. He is more likely to properly handle an emergency. Having a knowledge of the real nature of the process, he can more accurately diagnose troubles of operation, and with his wider field of information, even though much of it be theoretical, he may, if necessary, make use of more complex remedies for the difficulties than would be possible if his knowledge were limited to one line of experience.

Opportunities of the Man with College or Technical School Training, Plus Experience.

1. He is eligible for promotion to research in his field. A firm theoretical knowledge is indispensable in research, both in its planning and in its interpretation. Advanced commercial work—any chemical work, in fact, which is above pure routine—is essentially research.

2. He will find it comparatively easy to accept a position in a field different from that in which he is now engaged. The work will not be absolutely new—he knows the theory of the process already, and can rapidly gain experience.

3. He is available as an instructor in his special branch, or an allied branch of the science. A broad knowledge is fundamental to proper instruction.

4. With college or technical-school training in chemistry, he is equipped for advanced study and employment in other profitable sciences, *e. g.*, agriculture, medicine, geology, etc.

II. *Disadvantages of the Man with "Experience Only."*

1. He can not judge the efficiency of new processes, without costly experimentation. Having no theoretical conceptions, he can only "guess ahead," and determine by trial the correctness or error of his estimates.

2. He can not easily change to new formulae and methods.

Everything which he has not actually experienced is new to him. In attempting to understand a new process, he can not distinguish between the essential principles, which admit of no variation, and the lesser details, which might be radically altered to suit local conditions.

3. He can not test, purify or utilize crude materials. He must purchase purified materials, at whatever price their manufacturer may ask. The purity of his product is dependent upon the responsibility of other persons, over whom he has no control, and on whom he has no method of check. He may pay a high price for these imported articles, when quantities, almost as suitable, are at his very door.

4. He can not originate new processes and products. If he has the desire, he is likely to hesitate, because he can not be sure of his grounds. He is not familiar with his own field to its limits, much less is he willing to venture into unknown paths. This spirit was almost universal with the workers of this type in Nashville, who unhesitatingly pronounce their methods "the best," and declare that they know all they need to know.

5. He does not profit as rapidly and extensively by experience as does the trained man. He possesses nothing upon which to hang his fabric of experience—he must learn facts and manipulations in isolated sequence. He receives, after the lapse of sufficient time, a dexterity and familiarity in relation with the one process with which he is concerned which makes him an acceptable workman where the requirements are not rigorous.

6. An emergency is likely to present conditions which he will be unable to diagnose. His training is essentially one which serves only so long as the process is going smoothly. Makeshifts, substitutes and optional methods, unless obviously applicable, have probably not come within the range of his experience. In such a case, the services of an expert will of necessity be sought.

Opportunities of a Man with "Experience Only."

1. He soon reaches the limit of his scientific growth. As far as the actual manipulations of a certain process are concerned, his skill does not appreciably increase after a few months. He is not available for a position of research, as his knowledge is limited to his own experience.

2. The future for the rule-of-thumb paint mixer, the "ammonia man" at the gas factory, and others of similar employment, holds but little promise. Chemical routine is never remunerative. Why should it be? If financial reward is in any way based on the amount of intelligent effort necessary to

achieve success, what particular claims have these occupations which are quickly learned, and easily carried on—in which effort and study have been neither intensive nor extensive!

3. He is not an effective instructor, even concerning the processes with which he is familiar. He may be able to answer the question "How?" but can not explain the "Why?" of his methods. He can do a thing, while an apprentice watches and observes, but he can rarely explain clearly what he is doing. In my inquiries, this fact was noticed many times.

4. In some industries it is possible for the worker, after showing some abilities of an executive nature, to be advanced to a position of executive responsibility. But such is not the logical or the usual sequence. This is especially true of persons engaged in purely routine chemical work. The curse of rule-of-thumb training, so often, by a most egregious error misnamed "practical," is that it leads the worker into a blind alley occupation, in which he can soon reach the limit of his progress, and then go no further.

Chemistry, a Trade or a Profession?

Chemistry is distinctly a *profession*, rather than a *vocation*. It is to be classified with medicine, law and engineering, rather than with carpentry, bricklaying or plumbing. In a profession, more than an elementary study of its principles is necessary for efficiency, while in a vocation, the direct experience of labor, rather than theoretical study, makes a master of the trade. In a profession, one must show evidence of training in a recognized school, and be the possessor of degrees of proper kind, before he is accepted by his colleagues as a fellow. In a vocation, however, recognition is given to experience only—the schools which teach electroplating, photo-engraving, sign-painting, carpentry, plumbing, bricklaying, etc., being neither numerous nor largely patronized by the workers. It is apparent from the survey of the chemical industries of Nashville, that there are two recognized groups of workers—those who, after college or technical training, are properly designated as chemists, and those who, with experience only, may be recognized only as chemical artisans, more or less skilled.

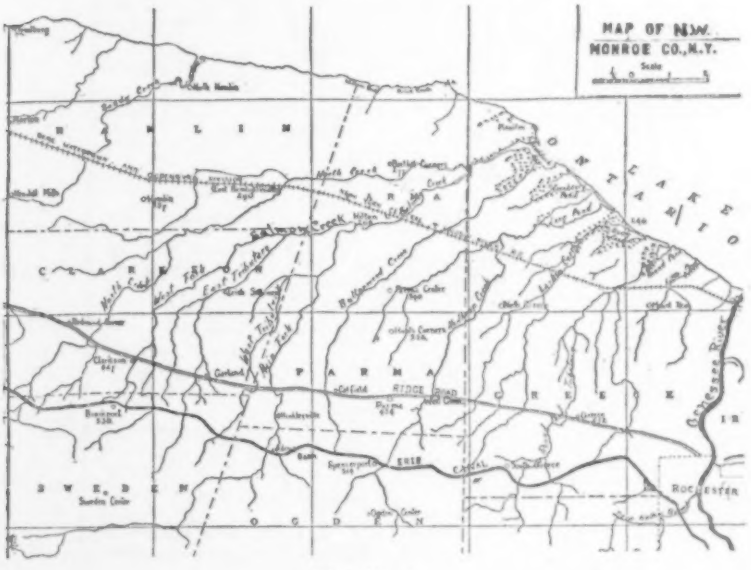
Therefore, "What is a chemist?" A man or woman of considerable educational attainments, versed in the history, literature, ethics and current progress of his cult, feeling the same pride in his life work which is common to all members of the "learned professions."

FISH SUCCESSION IN SOME LAKE ONTARIO TRIBUTARIES

By Dr. ALBERT HAZEN WRIGHT

CORNELL UNIVERSITY

IN the summer of 1904 the writer spent the whole season in surveying ten streams of Monroe County, New York, and in plotting the range of each species of fish in them according to a plan outlined in 1907.[1] The following year, 1908, tentative



MAP NO. 1.

conclusions were formulated and conditions in Cayuga Lake streams contrasted with those of Monroe County. In 1912 cursory work in Ontario province caused a revision of this draft.

In 1911 an independent study of the same sort was made by Dr. V. E. Shelford,[2] in the vicinity of Chicago and our studies are in general in agreement.

These ten Monroe streams (Map 1) to which I have alluded are quite ideal for the study of fish succession because they are

[1] *The American Naturalist*, Vol. 41, June, 1907, No. 486, pp. 351–354.

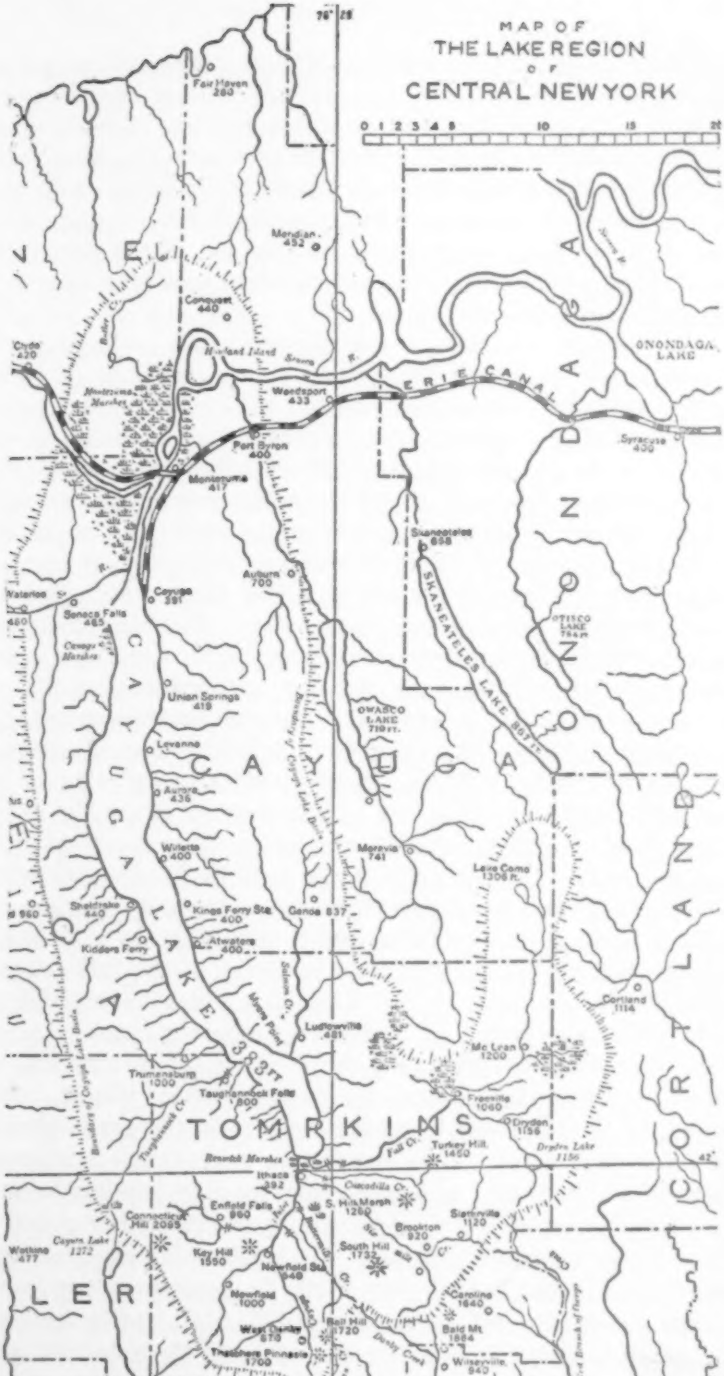
[2] "Ecological Succession. I. Stream Fishes and the Method of Physiographic Analysis," *Biol. Bull.*, Vol. XXI., No. 1, June, 1911, pp. 9–35.

in the old bed of Lake Iroquois and have come into being since its beach (Ridge Road on map) retreated to the present shore of Lake Ontario. They are then postglacial in origin and comparatively recent. For comparison, we have employed Meek's

MAP NO. 2.

results in the highlands of Ontario[3] (Map 2). He began at Hawkstone and Orilla on Lake Simcoe and followed the Grand Trunk railroad to Trout Creek (Lake Nipissing) or farther north. All the way northward this railroad bears away from Georgian Bay and the stations he successively came to were successively farther away from it in barriers, etc. Added to his results are the experiences of the writer from The Lake of Bays to Fletcher Lakes below Algonquin National Park. The northern end of Cayuga Lake (Map 3) is more comparable to

[3] Field Columbian Mus. Zool. Ser., Vols. I., No. 17; III., No. 7.


MAP OF
THE LAKE REGION
OF
CENTRAL NEW YORK
Fair Haven 260
Meridian 452
Conquest 440
Clyde 420
ERIE CANAL
ONONDAGA LAKE
Weedsport 433
Port Byron 400
Montezuma 417
Syracuse 400
Montezuma Marshes
Skaneateles 868
SKANEATELES LAKE 867 FT.
Auburn 700
Cayuga 391
Waterloo 450
Seneca Falls 465
OTISCO LAKE
OWASCO LAKE 710 FT.
CAYUGA
CAYUGA LAKE
Union Springs 419
Levanna
Aurora 435
Wells 400
Moravia 741
Lake Como 1306 ft.
Sheldrake 440
Kings Ferry Sta. 400
Genoa 837
Kidders Ferry
Atwaters 400
Cortland 1114
Ludlowville 481
Mc Lean 1200
Trumansburg 1000
Taughannock Falls 800
Freeville 1060
Dryden 1156
TOMPKINS
Turkey Hill 1450
Dryden Lake 1156
Ithaca 392
Enfield Falls 960
Brookton 920
Slaterville 1120
Connecticut Hill 2095
Key Hill 1550
South Hill 1732
Newfield Sta. 949
Newfield 1000
Caroline 1640
Watkins 477
Cayuta Lake 1272
West Danby 870
Bald Hill 1720
Bald Mt. 1664
Thatchers Pinnacle 1700
Wilseyville 940
Danby Creek
CORTLAND
ONONDAGA
LER
42°
76° 28'
MAP No. 3.

Monroe streams and its fish inhabitants bear out the contention. Many forms are common to the two but absent at the south end of Cayuga Lake. The upper reaches of the streams at Ithaca where barriers exist near the lake are more comparable to Otter Lake or Trout Creek of Ontario. Added to the results are the comparisons from some of the Susquehanna head streams, 8–12 miles south of Ithaca. These tributaries are, however, of another drainage system and may not be so pertinent to this discussion.

In a diminutive rivulet or a developing small creek where the current is moderate and the bottom clayey, gravelly or varied the first occupants are almost sure to be the sucker (*Catostomus commersonii*), the horned dace (*Semotilus atromaculatus*) and quite likely the black-nosed dace (*Rhinichthys atronasus*). The second seems to be the original and oldest carnivore of a typical eastern stream in its first development. Thus, in central New York, in most of the hanging valleys which empty into the Finger Lakes, suckers, horned dace and black-nosed dace are about the only original occupants above the high falls and toward the sources unless the brook trout (*Salvelinus fontinalis*) be present. In our ten Monroe streams we did not record the red-bellied minnow (*Chrosomus erythrogaster*), but Evermann and Kendall took it in Salt Brook, a small creek of Webster, and in Long Pond. In many streams and lakes of the province of Ontario it is one of the first to enter and might follow close after the above three species. This may explain its presence in the Cayuga Lake Basin only in the headwaters of Fall Creek where barriers intervene between its habitat and Cayuga Lake. Another form which was taken in a little side stream of the West Fork of Salmon Creek is the fathead minnow (*Pimephales promelas*). At Ithaca, the sole record for it is in the upper waters of one of our oldest streams, namely, Fall Creek (Meek, 1889) and above the barriers near Cayuga Lake; in some of the most inaccessible lakes (Great Lakes' drainage) of Ontario it is present as it is in the headwaters of the Susquehanna. In some streams or headwaters a representative of a very pretty group of minnows may possibly be associated with the last two species. It is either the red-sided minnow (*Leuciscus elongatus*) or Cope's minnow (*Leuciscus neogæus*). In the headwaters of the Susquehanna, the former is very abundant, and Evermann and Kendall had it from several small streams at the east end of Lake Ontario, while the latter form (*L. neogæus*) occurs in some of the highland lakelets of Ontario. In the Monroe County tributaries of Lake On-

tario, two minnows are amongst the species to follow after the original three as given above. These forms are the blunt-nosed minnow (*Pimephales notatus*) and the common shiner (*Notropis cornutus*). In the beginning, therefore, our small streams have in fish content a decidedly soft-rayed element. As the stream develops in width, length and diversity these forms either become our most adaptable forms and range throughout the length of the stream or betake themselves to the source or else succumb and therefore in a measure falsify the present record of fish succession.

The next incomers are usually the first of the spiny-rayed fish and are amongst the most diminutive, namely, the brook stickleback (*Eucalia inconstans*) and the fan-tailed darter (*Catonotus flabellare*). In some waters it would seem that almost concomitant with these comes the miller's thumb (*Cottus richardsoni*). Of this we are not so positive. In the smaller streams the stickleback is usually near the source and the darter may be at the source in mid-course or near the mouth. They are present, however, in almost every one of the Monroe County streams, irrespective of subsequent developments of the lower course, whether deep, muddy and marshy or swift, broad and gravelly. Following close on the heels of these spiny-rays comes the river chub (*Hybopsis kentuckiensis*) which we have recorded in all of our ten streams (small to large streams) and usually sparingly in mid-course or near the mouth. Another form which invades the new stream at about the same stage as the river chub is the stone-roller minnow (*Campostoma anomalum*), an upper course form if the lower course becomes muddy or a lower course form as well if the bottom becomes gravelly rocky or diversified. At this stage our hypothetical stream in its fish inhabitants virtually has its duplicate in Larkin Creek. Or this distribution of fish forms (river chub and stone-roller minnow not represented) is beautifully illustrated in the headwaters of Cayuga Lake Inlet. This stream is the only stream near Ithaca without obstructions or decided glaciated barriers.

The second carnivore and depredator of any size to enter is the pike (*Esox lucius*), closely associated with its smaller relative, the grass pike (*E. vermiculatus*). The former occurs in all ten Monroe streams, and it alone appears in Larkin Creek, while the grass pike occurs in seven streams. Where both are recorded the pike's range is usually greater, and it remains the longest in the oldest portions of a growing stream. This is illustrated in the Salmon Creek and in West Fork of Salmon

Creek, two stretches of the oldest stream courses under consideration. Here the pike alone remains, but in the more recent tributaries of each of these older streams both pike and grass pike occur and the former with the greater range.

About the time of the ingress of the pike, the lower course may possibly begin to deepen, the current become slower and the bottom muddy. Amongst the very first forms to appear along with such conditions is the common bullhead (*Ameiurus nebulosus*). This form is the most widespread in its distribution and most versatile in its adaptation of any of the three species of *Ameiurus* we have. Following the bullhead comes the first Centrarch, the common sunfish (*Eupomotis gibbosus*).

At this juncture our fish content compares favorably with the inhabitants of the upper reaches of Fall Creek Cayuga Lake) above the falls. The forms are: sucker, horned dace, black-nosed dace, fallfish (*Semotilus corporalis*), red-bellied minnow, fathead minnow, brook stickleback, miller's thumb, brook trout, pike, reticulated pickerel (*Esox reticulatus*), bullhead, and sunfish. Or Otter Lake above Lake of Bays (Ontario) may be comparable with its sucker, horned dace, red-bellied dace, fathead, Cope's minnow, blunthead, shiner, brook trout, bullhead, sunfish. Or Trout Creek, a small tributary of Lake Nipissing, may represent the same point with the following forms: sucker, horned dace, red-bellied dace, fathead minnow, blunthead, shiner, brook trout, brook stickleback, and sunfish. Or the very headwaters of the Susquehanna, nearest Ithaca, have a very similar fish fauna, to wit, sucker, horned dace, black-nosed dace, shiner, fathead, red-sided minnow, brook trout, miller's thumb, pike, pickerel, bullhead, and sunfish.

The golden shiner (*Abramis crysoleucas*) appears in quantity after the sunfish and is followed by a few perch (*Perca flavescens*) and the rock bass (*Ambloplites rupestris*). This summation or analysis of our ten streams has brought us unwittingly to the second youngest stream of the ten Monroe tributaries, namely, the West Tributary of the Main Fork of Salmon Creek. This tributary has only the forms recounted to this point.

The large-mouth black bass leads the way in the next associated group and occurs in eight of the ten Monroe streams. In four of the five main systems the black bullhead (*Ameiurus melas*) frequents the lower three or four miles of the stream. A close companion of the black bullhead is the tadpole cat (*Schilbeodes gyrinus*) which is recorded in five of the ten

Monroe streams and the mud minnow (*Umbra limi*) has much the same range and time of entrance. These four forms are almost synchronous in migration into the stream or the above order of the four may possibly show the succession. The first has, if anything, a longer range in the Monroe streams than the second, the second more than the third and the third more than the fourth if both occur in the same stream. We have now reached the third stage in our Monroe water courses, the state of affairs in the East Tributary of the West Fork of Salmon Creek. About this same period the Johnny darter (*Boleosoma nigrum olmstedi*) appears. It occurs in six of our streams or in five different systems, toward the gravelly, stony or clayey sources of two streams with muddy lower courses or in the mid-course of the other four more gravelly streams. In some streams the common killifish (*Fundulus diaphanus*) may enter soon after the previous forms or be associated with them. This development brings the succession to Round Pond Tributary.

A form which comes into consideration at this point is the chub sucker (*Erimyzon sucetta oblongus*). It was scarce in the West Tributary of Northrup Creek, rare in the lower part of Salmon Creek, and quite regular in the lower eight miles of North Creek, our most advanced muddy stream. Disregarding the lone bluegill (*Lepomis pallidus*) record, the West Tributary of Northrup Creek represents this stage. A common minnow (preferring a muddy sluggish course) enters. It is the Cayuga minnow (*Notropis cayuga*) and appears in the lower four miles of Buttonwood and North Creeks. The bowfin (*Amiatus calvus*) is associated with the three bullheads (*Ameiurus nebulosus, A. melas,* and *A. natalis*) in the lower part of two of the muddiest streams and occurs sparingly at the mouth of Salmon Creek. Requiring about the same conditions, the yellow cat (*Ameiurus natalis*) appears in a similar range. In one creek at one point we have the progress carried farther with the introduction of the pirate perch (*Aphredoderus saynnus*). This leaves us at the Buttonwood Creek stage. The pirate perch appeared more frequently in the more advanced muddy creek, namely, North Creek, and the succession in this stream goes even farther to the introduction of the mud darter (*Boleichthys fusiformis*). Upon the entrance of the small-mouth black bass (*Micropterus dolomieu*) at the mouth of North Creek on a few stony stretches we close this stream's development.

Thus we have from the beginning of muddy conditions the successive appearances of the common bullhead, common sunfish, golden shiner, perch, rock bass, large-mouth black bass,

black bullhead, tadpole cat, mud minnow, Johnny darter, common killifish, chub sucker, Cayuga minnow, bowfin, yellow cat, pirate perch, mud darter, and small-mouth black bass.

As the stream widens its valley, cuts back into the country, these forms push up to favorable habitats above or remain at the mouth or with increasing age of the stream may enter a tributary to recapitulate the succession beyond the first forms. For example, at Ithaca we have the Monroe succession being enacted in Fall Creek. It is naturally a wide, swift, gravelly stream from source almost to the mouth, and there are no decided muddy intervals except as produced by artificial mill dams. From its source to Cornell University campus (20 miles or more) we have most of the fish associates from the sucker to the common sunfish. Through the campus comes a deep rocky ravine with a series of high falls, the last one (Ithaca Falls) being only a short distance from Cayuga Lake. The run from the Ithaca Falls to the lake is short and takes the water mass of the upper 20 miles or more. As a consequence it is gravelly or stony, very swift and very short. There are, therefore, from source to Cornell University campus no attainable muddy stretches, because the postglacial falls bar entrance to the muddy associates of the mouth. Near the mouth of Fall Creek is a small tributary or bayou, deep and muddy, and in it we have the following: common bullhead, common sunfish, golden shiner, perch, rock bass, large-mouth black bass, Johnny darter, tadpole cat, common killifish, Cayuga minnow, in abundance according to the order of the list, *i. e.*, the first three being the most common. Just outside, and slightly above the mouth of this bayou, is the swift water of Fall Creek, where the small-mouthed black bass is the most frequent large fish present. Then follows the succession of the swift gravelly or sandy group to be discussed later. Thus, we have in the source of Fall Creek the first comers to the stream; then, the second muddy group can not follow after them because of falls, but rather go off into a side-stream near the mouth or remain in the mouth; over the backs of the muddy associates or past the mouth of the new home of these enters sparingly the third assemblage, to occupy only the one eighth of a mile stretch of gravelly or sandy bottom below Ithaca Falls. As a consequence, the succession is not carried as far as in the long well-developed lower course of Salmon Creek. The mouth of the West Fork of Salmon Creek in its fish content is about intermediate between the lower courses of Fall and Salmon creeks.

Some might feel that the Johnny darter should be thought

of as entering the succession after or near the small-mouthed bass, but this darter is not restricted to a gravelly bottom and swift current as many of the other darters are. Hence, its place with the previous forms. In the mouth or lower course of the West Fork of Salmon Creek we have left unmentioned in the succession silver-sided minnow (*Notropis atherinoides*), log perch (*Percina caprodes zebra*), spot-tailed minnow (*Notropis hudsonius*), and hog-nosed sucker (*Hypentelium nigricans*). Another place quite comparable is Lake Simcoe or Moon River just below Muskoka Lake (Bala). In the former Meek secured the silver-sided minnow, log perch, spot-tailed minnow, silvery minnow (*Hybognathus muchalis*), trout perch (*Percopsis omiscomaycus*), and long-nosed dace (*Rhinichthys cataractæ*); in the latter locality he secured log perch, spot-tail minnow, and silvery minnow. In the lower course of Fall Creek we have the silver-sided minnow, log perch, silvery minnow, spot-tail minnow, trout perch, satin-fin minnow (*Notropis whipplii*) and eel (*Anguilla rostrata*). In the spring the lampreys (*Petromyzon marinus unicolor*) and the calico bass (*Pomoxis sparoides*) and a stray gar (*Lepisosteus osseus*) may enter it. In Salmon Creek the succession has gone much farther. Besides the forms of Fall Creek we have in Salmon Creek the following: hog-nosed sucker, stone cat (*Noturus flavus*), green-sided dater (*Etheostoma blennoides*), straw-colored minnow (*Notropis blennius*), and the barred mad-tom (*Schilbeodes miurus*). Not infrequently a mullet (*Moxostoma aureolum*) or a bluegill may just enter the lower reaches of the stream. Rarely a sheepshead (*Aplodinotus grunniens*) or wall-eyed pike (*Stizostedion vitreum*) wanders into the mouth. Just at present the latest arrival in the lower reaches of the Salmon Creek seems to be the marine two-spined stickleback (*Gasterosteus bispinosus*). The forms above are the newest species of an older stream whose course becomes more diversified in general or at its mouth more like the Great Lake conditions. Some of the fish of this last group are as much lake species as stream inhabitants and some almost entirely lake forms. Salmon Creek has a much broader valley and longer course than any other of the Monroe watercourses previously considered and therefore has the succession farthest advanced.

The value of such an analysis as the above may not be apparent at once and may seem too speculative. But, if one considers a stream's drainage system, its size, and its geological history, he ought to be able to approximate its hypothetical fish content. Such studies may be an auxiliary in physiographic

work, *e. g.*, the writer when surveying Salmon Creek (not of Monroe County) of Cayuga Lake drainage discovered fan-tailed darters near its source and at once concluded there were no natural barriers in it from the lake to its source and the conjecture was right. Or it may be that the peculiar source inhabitants of some large creeks of glaciated areas may indicate that the upper half was connected with another drainage than the present one and a comparison of fish species may help to confirm such a contention. Often one may be at a loss to explain a certain species at the source of a creek and later find that it came across a divide from another drainage system and about Ithaca we have more than one instance of two sources being on the same level and continuous at floodtime.

One important recent factor in falsifying the record of fish succession is the rôle of our canals. The Erie Canal may be responsible for the several forms which occur at the northern end of Cayuga Lake, which make its fish population more like that of Lake Ontario or Lake Erie than like its own southern end. The most recent Erie contribution in the mouths of our Ithaca streams is the gizzard shad (*Dorosoma cepedianum*) and fifteen years ago or more one or more Monroe streams had in their upper courses, carp, eel, perch and spot-tail minnow contributed by the Erie Canal.

THE PLACE OF THE MUSEUM IN OUR MODERN LIFE

By F. H. STERNS, Ph.D.

THE great world war calls upon us, more insistently than anything else has done before, to evaluate anew much of our heritage from the past. Age-old institutions can no longer justify themselves by their antiquity. The time has passed when the mere performance, however satisfactory, of a function formerly valuable can be accepted as a substitute for present-day usefulness. We hold it to be our right to require of every custom, of every art, and of every organization a demonstration of its utility in our time and of its ability to meet our needs.

This does not mean that we have become materialists. Cultural values are just as important as they ever were. The demands of the human soul are not to be sacrificed to the desires of the body. But the soul values must be real, and not fictitious. Art, for example, must have something more to commend it than tradition. "Old masters" can no longer hold their places, unless they possess the merit of some supreme appeal to a universal sense of beauty (a test destined to remove many of them from their pedestals). Science, too, must be something more than scholasticism or a compendium of universal knowledge. Our schools must give us more than pedantry, and our churches more than ceremony. Although we do not intend to use a materialistic yard-stick for spiritual things, nevertheless we insist upon measuring them rigidly.

Among the institutions which "bake no bread," but minister only to the spirit, are museums, and these we now propose to examine. They have a respectable antiquity, but do they possess that which warrants the continuation of the expenditure of vast sums of money upon them? Have they functions to perform of sufficient importance to justify their enormous costs? If they have a purpose which the modern world can accept, do they fulfil it in a degree corresponding to the energies devoted to them? Are their dividends in life-values a reasonable return from our investment? Do they show a surplus or a deficit, when their complete accounts are balanced? Do they pay?

At the foundation of all museums are collections, and men

have been collectors almost since time began. The archeologist finds in the earliest village sites "caches" of multi-colored pebbles or curious fossils, while the same sort of objects occur in almost every "cabinet" in the United States to-day. Modern savages gather scalps or human heads, while the trophy instinct still exists among the hunters who make their annual pilgrimage to Maine. To-day our children collect buttons or marbles, our wives trading stamps or souvenir post cards, while we interest ourselves in coins or samples of ore.

The impelling force of curiosity has led many a man to gather and preserve unusual or mysterious objects. Specimens from foreign lands or from the depths of the sea have always had a wide appeal. Crystals, petrified objects, rocks supposed to contain precious metal, or stones weathered to a fancied resemblance to some living being or human artifact are frequent in collections. Skulls and Indian arrow heads are always saved. Things associated with the dead or with noted criminals possess a strong interest. Monstrosities and freaks seem irresistible.

Curiosity as a motive is supplemented by the sense of superiority gained from exclusive possession. The rarer the object is, the more it is to be desired. So the stamp collector seeks inverted centers and double surcharges regardless of any real significance these peculiarities may have. The art collector desires a genuine Rembrandt though it may be such an inferior product of the master's hand that it possesses little merit. The antiquarian boasts that he owns the largest accumulation of "problematical" forms in his vicinity, as if ignorance were a matter in which one could take pride.

The formation of still other collections has been promoted by intellectual interest. The scientist often preserves the objects he has gathered for study. He needs also to make "type" series for comparative purposes. So the student of art requires representative examples of each school or period of painting or sculpture. The teacher likewise must have illustrative specimens. Thus we find back of collecting the desire for knowledge, the lure of glory, or the sense of wonder.

Motives so different have necessarily led to very dissimilar results. Objects accumulated because of curiosity or the wish for exclusive possession are of one sort, while those gathered because of intellectual interest are of another sort. The one consists of the unique, the unusual, or the spectacular, while the other is made up from the normal, the typical, or the historically or scientifically valuable. The one is measured by the num-

ber or the rarity of its specimens, while the other is judged by their representativeness.

The motives which have inspired collection-making are the ones also which have given rise to museums. Popular curiosity, for example, supported the original Barnum and old Boston Museums, with their two-headed calves and three-legged chickens; and the same motive to-day keeps the dime museum alive. Our oldest American museum once had to depend for its existence on an appeal to this sense of wonder as the following advertisement will show.[1]

THE MUSEUM

OF SOUTH CAROLINA

In Chalmers' street, (near the City Square)

CONSISTING of an extensive collection of *Beasts, Birds, Reptiles, Fishes, Warlike Arms Dresses,* and other CURIOSITIES—among which are:

The HEAD of a New Zealand Chief
An Egyptian Mummy (a child)
The Great White Bear of Greenland
The Black and the Red Wolves of South Carolina
The South American Lion
The Duck Bill'd Platypus from New Holland
The Bones of an Ostrich as large as those of a Horse
The Boa Constrictor or Anaconda Snake, 25 feet long
The Grampus Whale, 20 feet long
800 Birds, 70 Beasts, 200 Fishes
4000 Specimens of Minerals.
Shoes of the Chinese Ladies, 4 inches long
The Saw Fish—Saw 4½ feet in length
A large collection of views of the Public Buildings, in Europe—and
A Fine Electrical Machine

The whole elegantly arranged in glass cases, open every day from 9 o'clock, and brilliantly illuminated every evening, with occasionally a Band of Music.

☞ Admittance 25 cents. Season ticket $1.; Children half price. ƒ Jan. 6

It would be hard to exaggerate the part played in the founding of museums by the sense of superiority derived from ex-

[1] This appeared in January, 1826, in the Charleston *City Gazette*. I copy it from the *Proceedings of the American Association of Museums*, Vol. 9, 1915, p. 59.

clusive possession. Collections made under the lure of such a motive attain their end in the fullest measure only when they are shown to some one. So what is more natural than that their owner should have them forever exhibited in a museum to a wondering public, with the name of the donor in a prominent place? Or that a museum should be started expressly to house such a collection? Or that this museum should bear the name of its rich patron? Need we mention the number of collections and museums called after wealthy men, or the number of tablets to the memory of those who financed some expedition, to show the importance of this motive in the history of museums?

In recent years, intellectual interest has become a prominent factor in the founding and continuation of museums. To demonstrate the truth of this statement, it is necessary only to cite the development of museums supported by universities and colleges, depending upon grants from city, state, or nation, founded and maintained by learned societies, or existing solely as educational institutions for children. These bodies propose to preserve articles of artistic, historic, or scientific worth, to advance research, or to diffuse knowledge as widely as possible.

Thus curiosity, the sense of superiority derived from exclusive possession, and intellectual interest are the foundations of museums as well as of collections. In the past, they supplied the motives for the building and supporting of such institutions. Is this true to-day? Do these organizations believe their functions to be the satisfaction of the sense of wonder, the desire for glory, or the passion for knowledge? Does the public which eventually pays the bills subscribe to these aims? What is the attitude, in regard to the old-time purposes, of the museums and their patrons?

If general tendencies may be regarded as evidence, the museums have repudiated the satisfaction of curiosity as their end. Undoubtedly it is still a motive for the visitor, and so appeal must still be made to it; but no well-organized modern institution will cater to it. They no longer find a place for freaks and monstrosities. One will search in vain for three-legged chickens or two-headed calves. Fakes, such as Barnum's mermaid which once excited so much attention, are rigidly barred. Museum curators devote much energy to the elimination of everything of doubtful authenticity, no matter how interesting it may be. Some places still cling to the old ways, but those of the better class tell us by their actions that they no longer consider it to be their function to satisfy idle curiosity.

Our museums must do something more for us than the movies or the circus. We will not be satisfied with petrified menageries. Nor do we care to support side-shows of freaks. The unusual and the meaningless can no longer occupy much of a place in our lives. To amuse is not now the function of a museum.

The sense of superiority derived from exclusive possession has likewise been discarded as an aim. The respectable museum no longer boasts of the uniqueness of its specimens. Things whose worth depends largely on their unusualness are not wanted at all. Objects of great rarity, but of real value, are freely shared with less fortunate institutions, either by the making of copies or by actual loan exhibits. No museum now would reserve for its own members the use and enjoyment of its collections. Self-glorification is no longer an approved motive.

Nor is the exaltation of the rich patron deemed any more commendable. Museums and collections are still called after founders or donors in many cases; but because of the increase of fine institutions and splendid accumulations of specimens which bear the name of no individual, this practice gives but little honor. Men are still impelled by the wish for fame to contribute to museums, but to-day their rewards are small. The promotion of the sense of superiority derived from exclusive possession, either of the museum or of its patron, has ceased to be a legitimate function.

The satisfaction of intellectual interest, on the other hand, as the aim of a museum has now received the sanction both of these institutions themselves and of the public which supports them. More and more are government agencies in city, state, and nation contributing to aquariums, zoological gardens, art galleries, and natural history museums, because they regard them to be essentially a part of the public school system. Universities and learned societies maintain many such institutions for research. There is an increased desire to interest the public, and to make the collections as useful as possible to investigators, to craftsmen, to the schools, and to the casual visitor. The ideal now is have every one who enters the museum building go out with a broader outlook on life, a deeper conception of the universe in which he dwells, or a keener appreciation of the true and the beautiful.

The accepted function now of a museum is to satisfy the thirst for knowledge or the love of beauty, especially by the use of specimens, models, or other objects appealing directly to the

senses. But for whom is it to do this? For the student of the future? Or for the investigator to-day? Or shall it be done for the general public? If for the first, we will store and care for the perishable materials of to-day that they may be ready for his use to-morrow. For the second, we should need to supply workrooms and equipment for research. For the third, there would be required proper installation and labeling of collections for exhibition purposes. Is the museum to be a warehouse, a laboratory, or a school, or all three? Is its function to preserve, to develop, or to disseminate the true and the beautiful.

We all recognize the necessity for the careful preservation of those objects which are desirable as records. Time is a great destroyer. Moths and rust corrupt, and thieves are apt to steal. Deterioration, such as is always taking place, progresses much faster when specimens are neglected. It is so easy to misplace things that it seldom happens that they can be found when they are wanted unless they have been cared for. Even if such an object is found, its parts may be so displaced that they can not be restored to their original arrangement, or its record may be lost, so that its exact value or even its authenticity may be open to question. Some person or some institution must make it a business to preserve anything of artistic, historic, or scientific value.

Certain commercial bodies exist for this very purpose. They possess the facilities necessary to do it. They have, for example, fire-proof vaults, in which the temperature and moisture may be properly regulated. They have locks and watchmen to guard against thieves. They are equipped to treat objects with preservatives and disinfectants, to minimize the destructive action of time and the elements, and of insect pests. They serve the public well.

Museums, on the other hand, often fail to perform this function as satisfactorily. The possibility of fire or theft is increased by the presence of visitors. Constant exhibition of an object allows injury due to sunlight. Handling by investigators and students exposes the specimen to misplacement, disarrangement of parts, or the loss of the accompanying data.

A museum can not remedy these faults without becoming a mere warehouse. Its whole nature is changed if it has no exhibits, no visitors, and no students. Professor T. H. Montgomery once described such a condition thus, "A museum that consists mainly of collections and of simple caretakers of the same has a speaking resemblance to a graveyard."

There can be no question but that a museum must store some

specimens. It can not exhibit everything it has at once. If it is to be a place for students and investigators, it can not be without large accumulations of "type" objects. But this necessary preservation for use is a very different matter from that sort of storage which would make the institution a "cemetery of bric-à-brac." A museum must store and care for perishable specimens, but this must not be its chief function. A museum is not primarily a warehouse.

This conclusion was once stated very aptly by Mr. F. A. Lucas as follows:

> A collection of specimens does not make a museum any more than a collection of paints and brushes makes an artist. It is not what we have, but what we do with what we have that produces results, and the true value of the museum does not lie in its specimens alone, but what it does or what is done with them.

Another writer tells us that "the museum should be more than a mere collection of specimens. It should be a house of ideas." This suggests very strongly that a museum's chief function is research. For how else do worth-while ideas arise? Is there any other way than by careful observation that we can obtain true conceptions of nature? Knowledge is advanced only by systematic investigations. So if a museum is to be more than a mere collection, if it is to be a house of ideas, some sort of research is imperative.

If a museum were a mere "old curiosity shop," if its place depended entirely on what its accumulation of objects was worth, or if it were merely a warehouse of valuables, still research would be important to it, because thus the value of its specimens would be enhanced. For even the curious demand a name and an explanation of what they see. If you can classify the object, and list its striking peculiarities, then it becomes still more a matter of interest. Even Barnum's famous establishment would not have survived if it had not labeled its curiosities with titles and descriptions.

When the specimens are documents of science or of history, their value depends upon what some one can read in them. Now if no one takes the trouble to read them, if no one by classification attempts to assign them to their proper position, if no one tries to relate them to others of their kind or to differentiate them from these, if no one cares to investigate their place or their authenticity, if no one believes that their evidence is worth the getting, then it will be difficult to persuade any one that they have worth-while evidence to give.

So it is with a work of art. If its beauty is such that no

one takes the trouble to see it, if no one cares which artist made it, if no one is concerned as to its age or genuineness, if its lessons in the history of art or in technique are of no value to any one, then no one will regard the specimen to be of worth.

Now all these things require some measure of research. Whether it be naming, description, classification, or explanation which is attempted, still some one must make some sort of investigation to accomplish it. Thus we find research important, even when the aim is merely the possession of valuable specimens.

The same is true when the object of a museum is education. Before any one can teach, he must first learn. If the institution is to disseminate knowledge, it must first acquire it; and this can be done only by careful investigation. The student requires labels giving names, description, classification and explanation; but the preparation of sound labels demands research. The more the museum has discovered, the more it can tell others; the sounder its own knowledge is, the more valuable will be its contribution to public education.

Further, the institution engaged in research can command the services of the most eminent and able men. It can thus have on its staff to arrange its exhibits, to label its specimens, and to educate its visitors, men whom it could not otherwise engage. To advance teaching, the best teacher possible must be obtained, and only by encouraging careful investigations can this be done. Thus research is a necessary function of a museum regardless of what its other aims may be.

Sometimes there has been a tendency to exaggerate the legitimate demand for research in a museum until it becomes the whole object of the institution. Often appeal is made exclusively to the learned and the specialist. Even to-day there are curators who cater entirely to a limited class of visitors. This attitude was voiced not so many years ago in the Association of American Museums thus:

> I consider the chief aim of a museum the advancement of science. This is its function; it must not go to the public; it must lead.

Now there is a certain danger here—even for the advancement of science. Research, the results of which are not applied or made available to the general public, but which are written up only for technical journals, has a narrowing influence. When one's audience consists exclusively of specialists, where one's entire effort is confined to one limited field, one is apt to lose a broad view-point; and then even the research work becomes sterile.

Besides, research is better carried out in other places. The great fields of nature are the places to study nature's ways. Museums at their best contain but a human selection of the things of the universe, and any conclusion based on their specimens is liable to errors due to the personal bias of the selector. Collections should represent the organized results of systematic investigations rather than their sole basis. Museums should be more of a record of researches successfully completed and now made available for all, than of places to carry on such work.

There is an increasing demand both on the parts of the museums and of the general public that the results of museum work should be made available for all, as the following quotation from Mr. Cheshire Lowton Boone will show.

> Now the mere collection and systematic study of things of nature and the doings of people is an occupation leading nowhere, profiting no one, and obviously ending in a cultural cul-de-sac, unless the student uses his research to illuminate some race problem. . . . I grant you the delight in personal vocations, because I have this in common with other men. But the most enthusiastic interest in science or art or literature as a justification for the maintenance of museums must, it seems to me, imply the advancement of culture, of social richness, and adjustment. In other words, those vast stores of reference material called museums must not only be indexed, classified, and studied, but exploited, and their significance laid bare for the benefit of the generations now and later. To this end the museum of whatever kind must, it appears, get into sympathy with the people, who are the ones to finally digest the results of expert study and perhaps lift themselves a peg intellectually.

This idea was brought out at one time even more strongly by W J McGee.

> The issue is between scientific research on one hand and education on the other. I think the prime function of a modern museum is education. The way in which science is best advanced is through research in the fields of nature and not in the museum. In order, however, that we may have naturalists forever with use and have an appreciation of the outside world we must educate the growing minds. The functions of a great public museum are education, the implanting in the minds of children and laymen of interpretative nuclei, interpretations of nature as it is represented, perhaps pictorially, but calculated to create an appreciation of nature in such a manner that the mind is stimulated and set to work.

That education is an important function of a museum, if not the main function, needs no further argument. The museums are rapidly coming to this position, and certainly the general public approves of it.

However, there still remains the question of the type of education to be given. Most of these institutions seem to be to-day in the position the universities were fifty years ago. They be-

lieve their function to be educational, but the public must have no say in what it will be taught. The museums have a "required course of study," and this is cultural rather than practical. A few great museums are now trying the "elective system," they have added technical and occupational "classes," and they are even going in for "university" extension. In this democratization of the museums, the needs and desires of the people are being taken more into account, and room is being found even for the craftsman. A museum's chief function is educational, in the widest sense of that term.

The purposes of a museum are: first, to disseminate knowledge, second to advance it by research, and third to do such other things as are necessary to the forwarding of its two chief aims (for example, the storing and preserving of objects of scientific, historic, or artistic value).

We are now ready to subscribe to the motto of the American Museum of Natural History, as expressed in its charter of 1869, "for the purpose of . . . encouraging and developing the study of Natural Science; of advancing the general knowledge of kindred subjects, and to that end of furnishing popular instruction," or, as it is printed on the museum's publications, "a free institution, for the people, for education, for science."

THE PHYSICAL TOLSTOI

By Dr. JAMES FREDERICK ROGERS
NEW HAVEN, CONN.

In the hidden bond between the soul and the body lies the solution of opposing aspirations.—Tolstoi.

THE physical biography of Tolstoi is easily written. The material has been abundantly furnished by reliable biographers, and we have the assistance also of our subject who, from an early date, was self-conscious and self-recording in regard to matters of the body as of the mind. It is interesting to observe the attitude toward the body which accompanied his varying views of life. Moreover, the influence of the physical upon the philosophical man stands out significantly.

Tolstoi inherited a body well fitted to house a colossal genius, and his early surroundings were such as to further his physical unfolding to the utmost. As a boy he was "interested in his father's dogs and horses," accompanied him in his hunting expeditions, and took a lively interest in all the "games and masquerades" in which the robust family amused itself.

His sensitiveness and self-concern early cropped out in distress over his homeliness and he tried to improve his appearance by clipping his eyebrows. He had "an ardent desire to fly," and persuaded himself that it was possible to do so. It was "only necessary to sit down light on your heels, clasping your arms firmly round your knees, and the tighter you held them the higher you would fly." Once when on a journey "he got out of the sleigh and ran, and was not overtaken until he had gone about two miles. He was lifted back into the carriage gasping for breath, perspiring and quite exhausted. Any one not endowed with the remarkable physical vigor," comments his biographer Maude, "that in spite of frequent attacks of ill health, has characterized Tolstoi through life, would probably have done themselves serious injury had they taxed their vital resources as recklessly as he often did."

When his brothers were sent to a riding school, Leo, although his father and the riding master insisted that he was too small, was also allowed to accompany them. "At the first lesson he duly tumbled off, but begged to be replaced in the

saddle, and he did not fall off again, but became on expert horseman."

In his college days Tolstoi says: "I perfected myself physically, cultivating my strength and agility by all sorts of exercises and accustoming myself to endurance and patience by all sorts of privations," *but* "his animal passions were strong, and the looseness of morals of society lent them rein. He gave himself freely to drinking, smoking, gambling, though these and other bad habits were easier to overcome than the desire for women." "I lead an animal life," he said, "though not quite debauched," for he saw the ugliness of his sins.

His dissipations brought his college life to an end with little apparent benefit. At nineteen, "on account of ill-health, and for private reasons," he left the university and returned to his estate. Fired with ambition to better the lives of the serfs, he entered upon the task of their reformation, but his enthusiasm was dampened by the slowness of results, and after a few months he abandoned his task and with his brother gave himself up to "hunting, gambling and carousing with Zigani dancers."

Debts and other results of his conduct brought a reaction. At twenty-two he tried to "simplify" life. He rented a cottage in the Caucasus for three dollars a month. "I dine at home," he writes, "on cabbage soup and buckwheat porridge, with which I am quite content." His years of bodily abuse had told upon him. "My health is not good. I am not ill, but I often catch cold and suffer from sore throat or from toothache or from rheumatism, so that I have to keep my room at least two days in the week."

He joined the army at twenty-two, and this entry in his diary for the next year shows his efforts toward a sober life. "Refrain from wine and women . . . the pleasure is so small and the remorse so great." If suffering more or less from minor ailments, Tolstoi, as a soldier, exhibited great physical strength and endurance. "One who entered his battery in the Crimea," just after Tolstoi left it, "says he was remembered there as an excellent rider . . . and an athlete who, lying on the floor could let a man weighing thirteen stone be placed on his hands and could lift him up by straightening his arms. At a tug of war (with a stick) no one could beat him."

If there were rifts in the clouds, the end of his "twenty years [from fourteen to thirty-four] of coarse dissipation" were not yet. At twenty-seven it was again "sprees, gipsy girls, and cards all night long," and he was frequently ailing

in body and in soul. "Gymnastics were fashionable in Moscow in those days and any one wishing to find Tolstoi between one and two o'clock in the afternoon could do so at the gymnasium in the Great Dmitrovka street, where, dressed in gymnastic attire, he might be seen intent on springing over the vaulting-horse without upsetting a cone placed on its back. He always," continues his biographer, "was expert at physical exercises: a first-rate horseman, quick at all games and sports, a swimmer and an excellent skater."

Fearless in the hunt, while pursuing a bear through snow, waist deep, the animal, to escape other hunters, took a cross path and came upon Tolstoi unexpectedly. When the bear was about six yards from him he fired and missed. "It was only two yards from him when his second shot hit her in the mouth but did not stop her onset. She fell upon him and Tolstoi felt his face being drawn into her mouth. He could only draw his head between his shoulders and try to present his cap instead of his face to the bear's teeth. Piercing the cap the teeth entered his flesh above and below his left eye. At this moment Ostachkof, armed with a small switch, came running up shouting at the bear, 'Where are you getting to? Where are you getting to?' at which the beast took fright and rushed off." When the wound was washed with snow and sewn up it proved to be trifling, though it left a scar.

At thirty-two, "a strongly built, broad-shouldered man," he delighted in bodily exercise and entertained his brother's children with gymnastic feats. "He would lie at full length on the floor, making them do the same, and then all would try to rise without using their hands." "He also contrived an apparatus out of rope which he fixed in the doorway; and on this he performed summersaults, to the great delight of his juvenile audience."

In establishing schools for the peasants "he had parallel bars and horizontal bars put up, and gave the children physical training." Like many other pioneers in gymnastic teaching, Tolstoi aroused suspicion, and to the effects of the novel exercises the peasant mothers did not fail to attribute any digestive troubles that befell their children from time to time; especially when the long Lenten fasts were succeeded by a return to more appetizing food, or when, after luxuries had long been lacking, fresh vegetables again came into use in summer."

Behrs, in his "Recollections," gives us a lively picture of the Tolstoi of this period. "With me, he liked to mow, or use the rake; to do gymnastics, to race, and occasionally to play

leap frog, or gorodki, etc. Though far inferior to him in strength, for he could lift 120 pounds with one hand, I could easily match him in a race, but seldom passed him, for I was always laughing. That mood accompanied all our exercises. Whenever we happened to pass where mowers were at work, he would go up to them and borrow a scythe from one who seemed most tired. I of course imitated his example. He would then ask me why we, with well-developed muscles, can not mow six days on end, though a peasant does it on rye bread, and sleeping on the damp earth? 'You just try to do it under such conditions," he would add in conclusion. When leaving the meadow, he would take a handful of hay from the haycock and sniff it, keenly enjoying the smell."

Though possessed of great strength and endurance, Tolstoi seldom enjoyed very long periods of uninterrupted health. His previous abundance of health had made habits of bodily care well-nigh impossible. "In early manhood he seems to have distended his stomach by imprudence in eating, and for the rest of his life he was subject to digestive troubles." At thirty-four we find him suffering from a cough and taking for it the "koumys cure." At fifty he writes: "A week ago I caught cold and fell ill, and only to-day have I come to life again;" and the next year—"Caught cold and was ill for a week."

Tolstoi had a contempt for doctors. "Like Rousseau he considered that the practice of medicine should be general and not confined to one profession; and this opinion inclined him to approve of the folk-remedies used by peasants. But he did not go the length of refusing to call in a doctor when one of the family was seriously ill."

The mental unrest to which, after middle life, he became a prey, told seriously upon his health. At fifty-seven his wife was much concerned, for "he has quite overworked himself. His head is always aching but he can not tear himself away" from his study.

At fifty-nine, for ethical reasons, he became a vegetarian. He gave up hunting for like reasons and abandoned tobacco as a harmful luxury. The latter renunciation was very difficult, but he finally lost all longing for it. He craved the mental peace of the peasant and sought it in manual labor. "What a delight it is," he exclaims, "to rest from intellectual occupations by means of simple physical labor! Every day, according to the season, I either dig the ground, or saw and chop wood, or work with scythe, sickle, or some other instrument. As to ploughing, you can not conceive what a satisfaction it is

to plough. . . . It is not very hard work, as many people suppose; it is pure enjoyment! You go along lifting up and properly directing the plough, and you don't notice how one, two, or three hours go by. The blood runs merrily through your veins; your head becomes clear; you don't feel the weight of your feet; and the appetite afterwards, and the sleep! For me daily exercise and physical labor are as indispensable as the air. In summer in the country I have plenty of choice. I can plough, or cut grass; but in autumn in rainy weather it is wretched. In the country there are no sidewalks or pavements, so when it rains I cobble and make shoes. In town, too, I am bored by simple walking, and I can not plough or mow there; so I saw or split wood. If for a single day I do not walk or work with my legs and hands, I am good for nothing by evening. I can't read or write, or even listen to any one with attention; my head whirls; there seem to be stars in my eyes, and I have a sleepless night."

Widow Anisyas's barn collapsed and Tolstoi helped to build another. He cut aspens in the forest, and "stripped and smoothed them with axe and plane." He was always first in the work—digging, preparing timbers, etc. He toiled from morning to night, proud to have done his work "with pains" and to have learned to execute some feat of handicraft.

Though he was proud of the work of his hands, it could not, in the nature of things, be as perfect as that of one who had made it his business and been trained from earlier life. Of the shoes over which he toiled for so many hours, a competent judge was so unkind as to remark that they "could not be worse."

That this period of hard muscular labor was also one prolific in valuable mental product indicates the enormous nervous energy at his command. We are reminded of that saner and happier though less robust philosopher, Emerson, who likewise sought the benefits of manual labor, but soon found that "when the terrestrial corn, beets, onions and tomatoes flourish, the celestial archetypes do not." "If I may judge from my own experience, I should unsay all my fine things, I fear, concerning the manual labor of literary men. . . . To be sure he may work in the garden, but his stay there must be measured, not by the needs of the garden, but of the study."

The following incident, occurring in his fifty-eighth year, offers a supreme example of Tolstoi's bodily powers. He wished to make the journey from Moscow to Yasnaya, a distance of a hundred and thirty miles. Disapproving of railways, but partly

for the sake of economy and from love of out-door exercise, he decided to walk the distance. "Over his shoulder he took a linen sack for his food, and in it he also took a pair of broad shoes, a soft shirt, two pairs of socks, some handkerchiefs, and a small vial of stomach drops, as he often suffers from indigestion. He started with three young men. Two of them broke down on the road and the count and his companion, after sleeping in hovels, reached their destination on the third day." On their arrival Tolstoi was "lively and merry" and expressed himself as having never enjoyed anything so much in his life.

Though Tolstoi appreciated the benefit of fresh air, muscular exercise and plain food, his hygienic knowledge or practise was not otherwise perfect. He ate "like a pig," and a famished pig at that. His son, Count Ilya, writes: "My father was very hungry as a rule and ate voraciously whatever turned up. My mother would stop him, and tell him not to waste all his appetite on *kasha,* because there were chops and vegetables to follow. 'You'll have a bad liver again,' she would say, but he paid no attention to her and asked for more and more, until his hunger was satisfied." Such a mighty machine needed plenty of fuel, but it is little wonder that with such stoking, there was frequent need of stomach drops.

Mental states had a profound influence on Tolstoi's bodily condition. Nor did his peasant practise long bring him mental peace. He was but a count masquerading as a serf. In his earlier years he had spent considerable time with music, had attained some proficiency as a pianist, and his appreciation was sane and his enjoyment of the art great until the dawn of his morbidly religious and socialistic phase. During this period Rubenstein played in Moscow. By natural desire Tolstoi wished to hear him and sent for a ticket. But on second thought he found that the attendance upon the concert was out of keeping with his lately expressed views of art. The distress of doubt as to the right conduct to pursue, and his desire to be sincere, brought on a "nervous attack" which prostrated him.

The same year in which he took his long journey afoot, Tolstoi was very sick with erysipelas, which developed from an injury to his leg. In spite of the pain and weakness, he persisted in following the plough. Pretending to have neuralgia, the Countess went to Moscow and brought back a physician. Tolstoi received him with much dissatisfaction, but finally allowed an examination which revealed a temperature of 104° and a badly swollen leg, from which pieces of dead bone came away. He was laid up for nine weeks, and in times of pain not

only did not forbid the coming of the physician, but more than once was glad to have him sent for at night.

At the age of sixty-six Tolstoi took boyish delight in learning to ride the bicycle. He acquired the feat without difficulty and could even ride without holding the handle bar. On May 2, 1896, he wrote in his diary, "I have stopped riding the bicycle. I wonder how I could have been so infatuated." But the joy of doing a physical feat with ease was not to be resisted and the next summer, at sixty-nine, he writes, "Went on my bicycle to Yasenki. I love the motion very much. But I am ashamed." He had always been fond of his horse, and at this time he often, after his literary work, took a ride of twenty miles, ending with a bath in the river. He was an expert swimmer and also a remarkably good tennis player.

After seventy his health became precarious. He suffered from angina pectoris, and following a severe attack at seventy-three he said to his daughter: "The sledge was at the door, and I had only to get in and go; but suddenly the horses turned round, and the vehicle was sent away. It's a pity, for it was a good sledge road, and when I'm ready to start again, it may be rough."

In the following year he suffered from inflammation of the lungs, and later, from typhoid fever. Always skeptical about medicine, he was surprised to note the stimulating effects of injections of camphor, and speaking in his humorous way he said: "Well, gentlemen, I have always spoken badly of doctors, but now that I have got to know you better, I see that I did you great injustice. You are really very good men, and know all your science teaches: the only pity is," he added, "that it knows nothing." A resident physician for Yasnaya was obtained on his account; but Tolstoi stipulated that the doctor must also be at the disposal of the neighboring peasants. His health improved greatly and in August of this year he was able to walk for two hours a day. Riding, the day after his seventy-fifth birthday, and wishing to spare his horse for a season, he got off and led it by the bridle. The animal trod on his foot and he was prevented from walking for some time.

At eighty-one he was still able to ride horseback, though vigor and certainty of mental and bodily processes were failing, and his death from pneumonia came in the following year, when, like an animal, he sought to retire from the haunts of his fellows to end his days alone.

The physical Tolstoi is the mirror of the mental and moral colossus that he was. It is interesting to observe the sway

which, for so long, his primitive somatic nature, by its very strength, held over him. He recognized the higher, though he followed the leadings of his lower nature. Though he knew the shallowness of pleasure and depth of regret which followed his conduct, his moral aspirations were continually swamped by his bodily automatism. If, like Saint Francis, he had early experienced a prostrating illness, his career might have been greatly altered. That his health was so little injured by the prolonged period of excess proves how wonderfully strong he was. The large crop of the golden grain of genius was, however, sadly mixed and marred by a late and abundant yield of wild oats.

It is especially noteworthy that Tolstoi, in his better moods, and after his emancipation from its sway, had the highest regard for the body and went to the utmost pains to bring it to and keep it at its best. To do so was an essential part of his religion.

JACOBUS HENRICUS VAN'T HOFF

VAN'T HOFF was born in Rotterdam in 1852, the son of a physician. He died in 1911. After completing his work in the Unversity of Leiden, he studied under Kekulé in Bonn and Würtz in Paris and obtained the doctor's degree at Utrecht in 1874.

When only twenty-two years old van't Hoff showed that certain unexplained cases of isomerism would be accounted for if structure formulas were so written as to represent the arrangement of atoms in space and not merely relations in a plane. The importance of this new point of view lay in the fact that it enabled chemists to classify substances which rotate the plane of polarized light and to predict what substances will possess this property. The branch of chemistry known as stereochemistry is the outgrowth of the paper published by van't Hoff in 1874 and of the independent statement of the same idea by LeBel a few months later.

In 1878 van't Hoff was appointed professor of chemistry, mineralogy and geology at the new University of Amsterdam. From this time forward his work has been in physical chemistry rather than in organic chemistry. In the next six years he rediscovered the law of mass action; he worked out the generalized theory of reaction velocities; he showed that the quantitative relation between chemical affinity and heat effect has the same form as the relation between electrical energy and heat effect deduced by Helmholtz. In addition to this he established the theorem which bears his name, on the quantitative displacement of equilibrium with change of temperature.

In 1885 a new period begins. Some experiments by the botanist, Pfeffer, were the starting-point. Pfeffer had been studying the rise of sap in trees and had found that a high pressure is necessary to prevent the diffusion of water through a membrane of colloidal copper ferrocyanide into a solution of sugar in water. Van't Hoff showed that the results of Pfeffer could be predicted if it were assumed that a dissolved substance exercises an osmotic pressure equal to the pressure which it would exert if converted completely into a gas occupying the volume of the solution and having the same temperature. This assumption not only explained Pfeffer's results, but also those of Racult on the vapor-pressures, boiling-points and freezing-points of solutions. When the osmotic pressure theory of

solutions was supplemented by Arrhenius's theory of electrolytic dissociation, it needed only the energy and enthusiasm of Ostwald to raise physical chemistry in the short space of twenty years to the position which it now holds.

In 1894 van't Hoff was offered the chair of physics at Berlin, made vacant by the death of Kundt. This was declined; but the ideal position offered by the Prussian Academy in the following year was accepted and van't Hoff left Amsterdam in 1896 for Berlin. Since that time he has worked systematically at a problem which had interested him off and on for many years previously. The special form of the problem was a systematic study of the conditions of equilibrium in their bearing on the salt deposits at Stassfurt, but the general results are applicable to all cases in which the deposits consist chiefly of any mixtures of the chlorides and sulphates of sodium, potassium, magnesium and calcium. Although not yet finished, the work is a masterpiece and shows what can be expected from an application of physical chemistry to geology and mineralogy.

The work of van't Hoff can be divided crudely into four parts: 1872–1877, organic chemistry; 1878–1884, chemical affinity; 1885–1895, theory of solutions; 1896–1904, oceanic deposits. Much of the organic chemistry of to-day is the direct outcome of the work done in the first period; the second and third periods made physical chemistry possible; the fourth period has probably introduced a new era in geology. It was because van't Hoff is a great exponent both of organic chemistry and of physical chemistry that he was the first man to be awarded the Nobel prize in chemistry.

VAN'T HOFF IN AMERICA

By Dr. BENJAMIN HARROW
COLUMBIA UNIVERSITY

ON the occasion of its tenth anniversary, the University of Chicago invited some distinguished foreign scholars to attend its celebration. Among these was Van't Hoff. Whilst on his journey Van't Hoff kept a brief diary which has since found its way into Ernest Cohen's life of the great Dutch chemist (in German).

No sooner were the necessary arrangements completed with Nef, representing the University of Chicago, than further invitations began to pour in from the American Chemical Society, from Yale, from Richards at Harvard, from Bancroft at Cornell, from Loeb at Wood's Hole, etc.

With his wife by his side, and with a dose of sodium cyanide in his pocket, to be used in case of accident—a typical European custom—Van't Hoff set sail from Rotterdam on May 21, 1901. Being a Dutch celebrity, the directors of the Holland-American Line set aside a stateroom for his use, and at table he sat with the captain on the one side and the Dutch Consul to St. Paul on the other.

The voyage, aside from a day of rough weather, was, on the whole, a pleasant one. Professor Webster Wells, of Boston, and Dr. Pettijohn, of Chicago, whom he met on board, proved agreeable companions. During the spare moments when talk and play did not occupy him, Van't Hoff busied himself with Loeb's work.

After landing in New York, where his pockets were searched by a custom-house official as though he were a pickpocket (!), Van't Hoff registered at the Savoy Hotel. Here troubles soon began. The taxi-man proved exorbitant. The wash basin in his room had unexpected possibilities. The shades simply could not be moved, as though defiant of European authority. And the trunk, without which outdoor life was not to be thought of, simply would not show up.

In good time things righted themselves somewhat. With the arrival of the trunk a brief stroll was undertaken. Everything was greeted with open-mouthed astonishment. Much was found that was beautiful; much that was ugly; but everywhere something very distinctively American was encountered. Upon his return, cards from Professor Chandler, from his son-in-law, Pellew, and from a reporter of the *New York Tribune*, together with an invitation to the Century Club, awaited him. This was evidently the beginning of American hospitality.

At luncheon there was a welcome introduction to ice-water —an unknown luxury in Europe. After the mid-day meal, Miss Maltby, of Barnard, whom Van't Hoff had met in Göttingen, called on him and his wife, and the trio started out on a stroll through Central Park and the Zoo, thence by bus to the "glorious" Hudson and Grant's Tomb, and finally to Barnard and the girls for supper.

The following day visits to Hale, to Chandler and to Pellew were planned. Brooklyn proved too complicated a center, and Hale could not be located. However, a sight of Brooklyn Bridge partially repaid his disappointment, for this structure aroused much admiration from the artistic scientist. The homes of Chandler and Pellew, "with their well-dressed ladies" were easier to find.

Not being expected in Chicago for some days, Van't Hoff

decided to visit some places of interest in this country. The first to be selected was Baltimore, with its Ira Remsen and Johns Hopkins. The country, as viewed from a Pullman, did not excite him much. One feature was the large posters along the road, announcing such items as "Baker's 5c Cigars, Generously Good," or "Omega Oil For Sore Feet, Stops Pain, For Headaches, For Everything." That, at least, was America with a vengeance! Passing into Philadelphia over the Delaware recalled the story of the famous crossing and the chain of dramatic events that followed it.

Baltimore was much more after his own heart. There was none of that breathless living so characteristic of the Empire City. Here people lived more on the style of the Rotterdammers and Amsterdammers.

At the University he met his old pupil, Harry C. Jones, whose open-hearted laughter, with his "all right" and "first-rate" and "that's it" won Van't Hoff completely. Here he was shown the first of the series of classical researches on osmotic pressure, so intimately associated with the name of Morse.

The greeting by President Remsen and the faculty in the Senate House was most cordial. "Really great" was a phrase used, and Van't Hoff felt satisfied. The lunch at Remsen's which followed it, however, was too exclusively American; particularly the grape-fruit, which Van't Hoff had not, as yet, cultivated a taste for.

On to Washington! More south! More negroes!! Fans!!!

Here the trusty Baedeker did yoeman service—whether at the Capitol, or at Howard University (a university for negroes!), or at the Geological Survey, or at the Smithsonian Institution, or at Mount Vernon. There was much to admire. And Day, and Clarke, and Hillebrandt, of all of whom he had heard much, he was glad to meet.

Over the Lehigh Valley to Mauch Chunk, the "American Switzerland," with its immense coal-fields, and thence to Ithaca. Here some delightful hours were spent with Bancroft and his wife. An introduction to President Schurman gave occasion for a discussion on the influence of the money-kings on the development of American universities. This was apropos of the dismissal of a professor who professed leanings towards socialism. Their next stop was in Buffalo, where the Pan-American Exposition and the grand Niagara Falls were visited.

From Buffalo Van't Hoff proceeded direct to Chicago. The Pullman arrangements were an unpleasant surprise to him. He recalled how traveling from Paris to Strassburg each pas-

senger had his own little room with his own wash-stand. But these common sleeping quarters, stiflingly hot and uncomfortable, with one wash-stand for all!

At Chicago Nef had undertaken to look after his comfort, and the result was everything that could be desired. His suite at the Hotel Windemere was ducal in pretentiousness.

The first part of the celebration consisted of a reception tendered by Mr. Rockefeller. Here he made the acquaintance of Stieglitz and Alexander Smith. In the afternoon Van't Hoff delivered the first of his promised addresses, and this duly made its appearance in *Science*. Later on, Nef took him to a baseball game which was to be played between Chicago and Michigan, and here, for the first time, Van't Hoff really understood just what baseball is. It would seem that while in Washington he had one day watched a steamer crowded with lively young girls depart for a baseball game. At that time our learned professor was of the opinion that baseball was some sort of a dance!

In the evening the president tendered a dinner to his guests. Van't Hoff was seated between M. Cambon, the French Ambassador, and Professor Goodwin, of Harvard. Goodwin considered Van't Hoff's speech on the occasion—"American Ideals"—the best, because it was the shortest! Rockefeller's presence made wine or beer out of the question.

Following this came the general reception, which was most noteworthy for the immense crowd which had been gathered there. Van't Hoff retired to a quiet corner with Alexander Smith, "an extraordinary tall colleague."

The following day—June 18—began with the laying of the foundation stone. The heat was terrific, and poor Van't Hoff fell quite asleep during the long-drawn-out speeches.

Then came the awarding of degrees. All the honorary recipients were there, with the exception of the Russian, who had got his dates confused because of sticking too close to his Russian Calendar!

Fully one half of the students who received degrees were girls. This was an excellent augury for the future, thought Van't Hoff, and the thought he conveyed to an acquaintance sitting near-by. This man explained the university's point of view by saying that the authorities did not greatly encourage the girl graduates to seek positions, but did like to see these same girls marry rich men. Why? Because it would then be the duty of these girls to interest their *rich* husbands in the needs of the university. Was the man serious?

Van't Hoff was among a few to receive the honorary degree of Doctor of Laws.

At 1 P.M. came the alumni dinner, and Van't Hoff was honored by being seated next to Rockefeller. Very little conversation was carried on with the oil magnate, because this gentleman seemed much too preoccupied with his coming speech. When Rockefeller's turn did come, he commenced with a story about a negro who was asked what he thought of Jesus, to which the negro replied, "I have nothing against Him." With this, Rockefeller turned to the public and said, "I have nothing against you." Van't Hoff does not tell us how the millionaire further developed his speech.

Again not a drop of alcohol on the table! Again Rockefeller's influence!

The next four or five days were mainly occupied with the preparation and deliverance of the lectures—since published and translated into English by Alexander Smith.

On the 24th of June Van't Hoff departed for Cambridge. At Boston he was met by Richards, who had provided for his comfort as liberally as had Nef at Chicago.

On the 26th, which was the day of Harvard's Commencement, Van't Hoff was presented for his honorary degrees as "the greatest living physical chemist," a statement which was received with much applause. The lunch at Memorial Hall which followed was chiefly memorable because of Roosevelt's presence. The well-advertised teeth showed prominently. The evening was spent at the homes of Richards and Münsterberg. The following day, with Jackson and Richards as guides, Boston's sights were carefully inspected. In the evening he was the chief guest at a dinner which included President Eliot, Richards, Jackson, Pickering, Trowbridge, Hill, Michael and Bancroft. Gibbs and Crafts sent regrets. Van't Hoff was seated next to Eliot, who discussed with him the possibility of losing Richards, at that time considered as a probable successor to the chair of chemistry at Göttingen—an unusual distinction for an American!

Van't Hoff took his departure from this country highly impressed with all that he had seen. He prophesied that within fifty years American universities would seriously rival those in Europe. It is but seventeen years since he has been here, but his prophecy has already come true.

THE PROGRESS OF SCIENCE

ANDREW DIXON WHITE

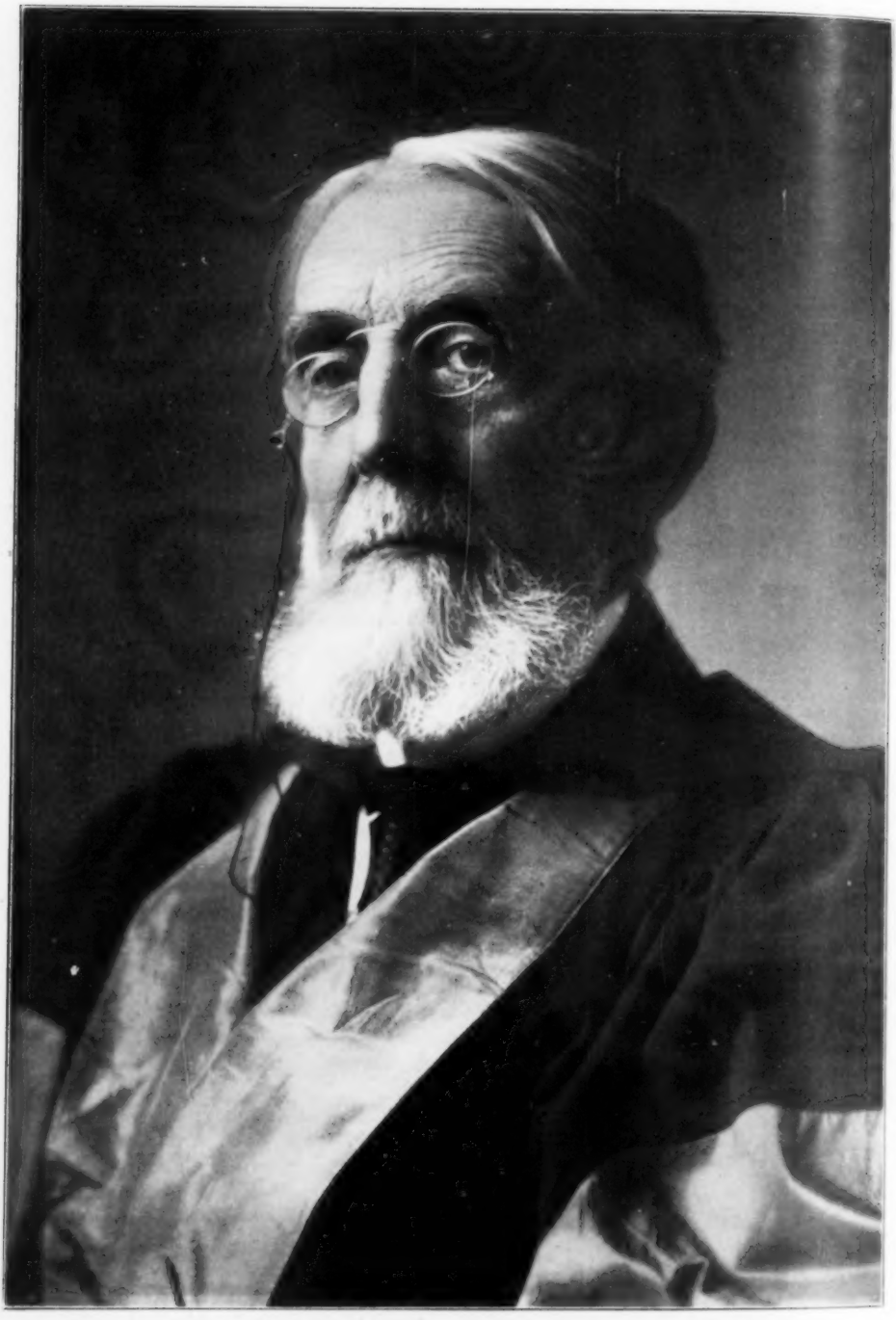
THE death of Andrew Dixon White at the close of his eighty-sixth year completes a life of fine performance. Three great university presidents, White at Cornell, Angell at Michigan and Eliot at Harvard, were the leaders in the development of our system of higher education. Theirs is not the blame if the office has been magnified by their qualities so as to become dangerous in the hands of lesser men.

White and Ezra Cornell were members of the New York State Senate in 1863, when the question of the disposal of the land grant for colleges of agriculture and the mechanic arts was under discussion. As the result of conferences between them, Cornell gave $500,000 to establish Cornell University in cooperation with the land-grant college. White was elected president of the new university, and served in that office for twenty years. Through his influence there was established an institution for advanced instruction and research in which science, pure and applied, had an equal place with letters, and in which the students were in large measure released from pedantry and routine. It was provided at the outset that "no professor, officer, or student shall ever be accepted or rejected on account of any religious or political views which he may or may not hold."

White once told the present writer the story of how nearly he had repeated the experience with Mr. Cornell. A prominent benefactor had provisionally accepted his plans for a national university at Washington with an endowment of forty million dollars, but was finally dissuaded by those who looked askance on such an institution.

White was professor of history and English literature at the University of Michigan from 1857 to 1863, having been appointed to his chair at the age of twenty-five years, after his return from three years' study in Europe. During that time he had been an attaché of the American legation at St. Petersburg and at Moscow. In 1867 he was made minister to Germany, which post he occupied as ambassador from 1897 to 1902, having from 1897 to 1914 served as minister to Russia. He was also active in diplomatic and political affairs at home. Even last summer at the age of eighty-five years he spent several weeks in Washington as an adviser of President Wilson.

White was also an author of distinction. In this place it is becoming to state that he was one of three men whose contributions did the most to make *The Popular Science Monthly*, on the editorial lines of which this journal is conducted, a leader in the emancipation of science and of thought in this country. It is difficult for us to understand the bitterness with which Darwin and the theory of evolution were opposed when the *Monthly* began publication in 1872. To it White contributed twenty-eight articles, Herbert Spencer ninety-one and Huxley forty-four. Those of White's articles concerned with the struggle of science for freedom were subsequently published in book form under the title "A History of the Warfare of Science with Theology," a work of fine scholarship and wide influence. White was the author of a number of books concerned with



ANDREW DIXON WHITE.

economics, history, education and social conditions. In 1905 he published the autobiography of a life of unusual usefulness and distinction.

FREEING THE FOREST RESERVES FROM PREDATORY ANIMALS.

SKILLED hunters in the employ of the government are waging persistent warfare against the predatory animals that prey on sheep and cattle in the western states. Their efforts are encouraging stockmen to increase live-stock production on the federal forest reserves as well as in the range country, and they are protecting the sources of supplies of meat, leather and wool now in the western grazing districts.

Hunters of the Biological Survey of the United States Department of Agriculture have killed 70,713 predatory animals during the last three years, which has resulted in a direct saving estimated at nearly $5,500,000 a year to the stockmen of the Rocky Mountain section. The total number killed since the fall of 1915, when the work was started, includes 60,473 coyotes, 8,094 bobcats, 1,829 wolves, 201 mountain lions and 137 bears. The government experts estimate that the annual depredations among cattle and sheep effected by single predatory animals are as follows: wolf, $1,000; stock-killing grizzly bear, $500; mountain lion, $500; bobcat, $50; and coyote, $50.

Stockmen in sections where the predatory animals are obnoxious are aided by the government in ridding the ranges. In some localities the stockmen's associations cooperate with the state and federal authorities in the extermination campaign, professional hunters being employed to detect and kill the animals that prey on sheep and cattle. Illustrative of the scope of this work, the total income from pelts of predatory animals killed by government hunters last year amounted to approximately $100,000. In addition many other animals whose skins could not be reclaimed were killed by poisoning. Ordinarily the United States Biological Survey has from 250 to 350 professional hunters permanently in its employ. The area wherein predatory animal control is practiced includes ten districts: Montana; Idaho; Washington and Oregon; Nevada and California; Utah; Wyoming and South Dakota; Colorado; Arizona; New Mexico; and Texas.

During the last twelve months 26,226 coyotes, 3,458 bobcats, 849 wolves, 85 mountain lions, and 41 stock-killing bears have been disposed of at an annual saving of approximately $2,400,000 in domestic stock. Recently a government hunter shot two male wolves which had killed 150 sheep and 7 colts on two Wyoming ranches, while another trapper bagged a pair of old wolves which had a record of killing $4,000 worth of live stock a year. A third trapper destroyed 85 coyotes and 2 bobcats in one month, using 6 horses and 200 traps over a trap line varying from 50 to 100 miles in length. A coyote was recently captured which had destroyed $75 worth of sheep in one week. Two wolves, seven mountain lions, and a grizzly bear, the largest of its species ever killed in the Yellowstone Park section, were shot by another sharpshooter. These results are typical of the campaign destined to free the Rocky Mountain range country of predatory animals.

THE BALTIMORE MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE meeting of the American Association for the Advancement of

SKINS OF SOME OF THE LARGER PREDATORY ANIMALS ON AN OREGON NATIONAL FOREST.

Science and of the national scientific societies affiliated with it, which it has been planned to hold this year in Boston, has been transferred to Baltimore in order to reduce as much as possible the need for traveling and to be near Washington, which has become the center of scientific activity of the country. It is planned that the programs of the association and of the affiliated societies shall be mainly directed to questions of national welfare, national efficiency and national defense; they will demonstrate the value of science and of the work of scientific men to the country. Dr. L. O. Howard, the permanent secretary of the association, under the date of October 16, addressed the following letter to the secretaries of the affiliated societies:

Something of a complication has arisen in connection with the meetings of the American Association for the Advancement of Science and the affiliated societies.

The Johns Hopkins University has taken on the Students Army Training Corps and, therefore, its courses are largely revised and its faculty is very busy. Their Christmas vacation runs only from the 22d to the 29th of December, both dates inclusive.

I had expected to be able to utilize the facilities of Goucher College, but this institution has now been closed by the epidemic of influenza and will probably have to be in session during Christmas week.

The present situation leaves for our meeting dates the 23d and 24th (then comes Christmas Day) and the 26th to the 28th, these being the only dates in which certain of the lecture rooms of Johns Hopkins can be used by us.

The committee on policy of the association has decided to adhere to its decision to meet in Baltimore, but there must be some change in plans, both on account of the small size and number of lecture rooms available and the fact that there are practically no hotel accommodations. Members will have to rely almost entirely upon lodging-houses.

It is obvious that for certain of the affiliated societies the 23d and 24th should be selected and, for others, the 26th to the 28th, since rooms vacated on the night of the 24th can be used by members of the affiliated societies meeting on the 26th to the 28th.

It is planned to have the opening meeting of the American Association on the night of Thursday, December 26, although meetings of the sections may be held during the day of the 26th.

SCIENTIFIC ITEMS

WE record with regret the death of Major Alfred Reginald Allen, instructor in neurology in the University of Pennsylvania, killed in France; of Captain George S. Mathers, of the McCormick Institute for Infectious Diseases, and of Lieutenant Admont Halsey Clark, M.C., U. S. Army, assistant professor of pathology in Johns Hopkins University.

THE Prince of Wales has accepted the position of patron of the Ramsay Memorial Fund, founded in November, 1916, to raise £100,000 as a memorial to the late Sir William Ramsay. The committee has already collected £37,000, and subscriptions from oversea committees will probably bring the total to £50,000. It is proposed to raise the remaining £50,000 by a million shilling fund, now opened with a donation of 1,000 shillings from the Prince of Wales. Already over 10,500 shillings have been subscribed. The fund will provide Ramsay Research Fellowships and a Ramsay Memorial Laboratory of Engineering Chemistry in connection with University College, London. Donations from one shilling upwards should be sent to the honorable treasurer, Lord Glenconner, at University College, London.

ACCORDING to a press dispatch from Paris Dr. Alexis Carrel, of the Rockefeller Institute for Medical

Research, was recently seeking a building at Saint Cloud suitable for a laboratory and workshop near certain hospital centers. He found the house he wanted in a park full of splendid trees. The property belonged to André Bernheim, who had refused all offers to rent it on account of the family souvenirs it contained and the art treasures. When Mr. Bernheim heard of Dr. Carrel's wish to lease his house he said: "Tell Dr. Carrel that I am greatly flattered at his choice and that the Verger and its surroundings are at his service." When the question of rent was raised, Mr. Bernheim declared, "No, no, a scientist owes nothing to anybody. It is I who am honored."

INDEX

NAMES OF CONTRIBUTORS ARE PRINTED IN SMALL CAPITALS

SCIENTIFIC BOOKS

THE CONTROL OF HUNGER IN HEALTH AND DISEASE

By ANTON JULIUS CARLSON, *Professor of Physiology at the University of Chicago.*

A summary of the work of the stomach, with special reference to hunger and appetite, carried on at the Hull Physiological Laboratory, at the University of Chicago during the last four years. 219 pages. Price $2.00 net.

University of Chicago Press, Chicago, Ill.

STATE SANITATION

By GEORGE CHANDLER WHIPPLE, *Professor of Sanitary Engineering at Harvard University. Member of the Public Health Council, Massachusetts State Department of Health.*

The primary object of this book is to set forth the past work of the Massachusetts State Board of Health, so that it may be known by the people of the present generation. 377 pages.

The Harvard University Press, Cambridge, Mass.

PRINCIPLES OF OCEAN TRANSPORTATION

By EMORY R. JOHNSON, PH.D., SC.D., *Professor of Transportation and Commerce of the University of Pennsylvania*, and GROVER C. HUEBNER, PH.D., *Assistant Professor of Transportation and Commerce at the University of Pennsylvania.*

This book embodies all the principal changes that have recently occurred in methods of ocean transportation throughout the world. Illustrated with half-tones, maps and diagrams. 513 pages.

D. Appleton and Company, New York City

DESCRIPTIVE MINERALOGY

By WILLIAM SHIERLEY BAYLEY, *Professor of Geology at the University of Illinois*

A text-book for college classes, designed to give the student a comprehensive view of modern mineralogy, rather than a detailed knowledge of many minerals. 268 illustrations. 542 pages.

D. Appleton and Company, New York City

INORGANIC CHEMISTRY

By ALEXANDER SMITH, *Professor of Chemistry in Columbia University.*

A thorough treatise of inorganic chemistry for students beginning this study in college, university or professional schools. Third edition. 925 pages.

The Century Co., New York City

SOIL PHYSICS AND MANAGEMENT

By J. G. MOSIER, B.S., *Professor of Soil Physics, University of Illinois*, and A. F. GUSTAFSON, M.S., *Assistant Professor of Soil Physics, University of Illinois.*

The publication of this book fulfils three purposes: First, a text-book for agricultural students; second, a reference book for the practical farmer; and, third, an aid to the landowner who desires information in the management of his land. 202 illustrations. 442 pages.

J. B. Lippincott and Company, Philadelphia, Pa.

FIELD BOOK OF INSECTS

By FRANK E. LUTZ, *Associate Curator, Department of Invertebrate Zoology, American Museum of Natural History*

A popular treatise of the more common insects, with special reference to those of the Northeastern United States. 800 illustrations. 400 pages. Price, $2.50 net.

J. P. Putnam's Sons, New York City

A TEXT-BOOK OF PRECIOUS STONES

By FRANK B. WADE, B.S., *Head of the Department of Chemistry, Shortridge High School, Indianapolis, Ind.*

This book presents, in as natural an order as possible, the fundamental principles and methods in use for identifying precious stones. 318 pages. Price, $2.00 net.

J. P. Putnam's Sons, New York

COMPARATIVE ANATOMY OF VERTEBRATES

By J. S. KINGSLEY, *Professor of Zoology at the University of Illinois*

A text-book of comparative anatomy, laying special emphasis on the embryological side of the study. Second edition. 406 illustrations. 449 pages. Price, $2.00 net.

P. Blakiston's Son and Company, Philadelphia, Pa.

TOPOGRAPHY AND STRATEGY IN THE WAR

By DOUGLAS WILSON JOHNSON, *Associate Professor of Physiography, Columbia University.*

This book treats the relationship between inanimate nature and the science of war and gives a picture of the different war fronts in order that the military campaigns of the war may be followed with greater ease. 211 pages. $1.75 net.

Henry Holt & Co., New York

GENERAL ZOOLOGY

By A. S. PEARSE, *Associate Professor in the University of Wisconsin.*

This book has been written to be read by students of eighteen to twenty years of age. With this idea in view both the illustrations and text have been prepared more in the style of a natural history than of an anatomy. 366 pages.

Henry Holt & Co., New York

HISTORY OF MEDICINE

By FIELDING H. GARRISON, *Principal Assistant Librarian, Surgeon General's Office, Washington, D. C.*

This volume has been written with a definite intention of stimulating the student to do his own thinking and research, by interesting him in the subject from the start. 905 pages. Cloth $6.50 net.

W. B. Saunders Co., Philadelphia, Pa.

A SHORT HISTORY OF SCIENCE

By W. T. SEDGWICK and H. W. TYLER *of the Massachusetts Institute of Technology.*

This volume seeks to furnish the student and the general reader with a concise account of the origin of our scientific knowledge and scientific methods. 474 pages. Price $2.50 net.

The Macmillan Co., New York

EVERYMAN'S CHEMISTRY

By ELLWOOD HENDRICK, New York City.

This book aims to give to the average man a general realisation of the tremendous importance of chemistry and its application in actual life. 373 pages.

Harper & Brothers, New York

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. **GARRISON, NEW YORK.**

Sub-Station 84: New York

The Scientific Monthly

Entered as second-class matter October 1, 1918, at the post-office of Lancaster, Pennsylvania, under the Act of March 3, 1879

CONTENTS OF THE OCTOBER NUMBER

CONTENTS OF THE NOVEMBER NUMBER